

1884
BULLETIN

OF THE

Iowa Agricultural College,

ISSUED BY THE

DEPARTMENT OF BOTANY,

November, 1884.

CHARLES E. BESSEY, PH. D., PROFESSOR OF BOTANY.

CEDAR RAPIDS, IOWA:

DAILY REPUBLICAN PRINTING AND BINDING ESTABLISHMENT.

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ERRATA.

- PAGE 109. In the first line of the second paragraph insert *to* after *as*, and in the same paragraph in the eighth line, for order read orders.
- PAGE 130. In the heading to the article for *purpurea* read *purpurea*.
- PAGE 133. For Preliminary Lists Cryptogams, read Preliminary Lists of Cryptogams.
- PAGE 134. Line 17 from the top, omit the word *two*.
- PAGE 138. Fourth line from the top, for slimey read slimy.
- PAGE 138. Nineteenth line from the top, in the second word the final diphthong should be æ.
- PAGE 139. Seventh line from the top, the spelling of the second word should be *Ædogoniaceæ*.
- PAGE 154. Insert a period after the abbreviation UROM. Nos. 15, 18 and 19.
- PAGE 154. In the the footnote the value of a micromillimetre should be given as *one-millionth* of a metre.
- PAGE 155. Ninth line from the bottom, for *strieta* read *stricta*.
- PAGE 156. Third line from the bottom, for urespores read uredospores.

IOWA AGRICULTURAL COLLEGE.

DEPARTMENT OF BOTANY.

AMES, IOWA, November 3d, 1884.

The following pages are issued in order to give the people of this State an idea of the nature of the observations which are made and the study carried on in the Department of Botany of the College. For convenience the matter is divided into two parts. In part I, popular descriptions of some of the harmful plants, which are so abundant, are given. It is hoped that by the aid of the illustrations given it will not be difficult for any one to recognize them. The text has purposely been made non-technical, so that it may be easily understood by all.

In part II, I have brought together what is known as the lower forms of vegetation growing in this immediate flora, taking in an area covered by a radius of about twenty miles. I trust that my non-botanical friends will not regard this portion of this bulletin as useless, for it is by such work that we lay a foundation for those studies which eventually lead to beneficial practical suggestions as to remedies against the harmful fungi, means for checking and avoiding them, etc., etc. Of the most harmful order of fungi, viz. the Rusts and the Smuts, as complete lists as possible of those in the whole state have been made out at my request by Professor J. C. Arthur, formerly an instructor in this college, and now botanist to the New York Agricultural Experiment Station.

CHARLES E. BESSEY.

PART I.

POPULAR DESCRIPTIONS OF SOME HARMFUL PLANTS.

1. THE RATTLE-BOX OR RATTLE-POD.
2. THE INJURIOUSNESS OF PORCUPINE GRASS.
3. THE STINKING SMUT (OR BUNT) OF WHEAT.
4. THE BLACK SMUT OF WHEAT, OATS AND BARLEY.
5. THE SMUT OF INDIAN CORN.
6. THE ERGOT.

THE RATTLE-BOX.

(*Crotalaria sagittalis* Linn.)

This plant is also known as the Rattlepod, and it has been named in some parts of the country Wild Pea, a name which should not be persisted in as it is in no sense a Pea. The name I have used—Rattlebox—is to be preferred, and should be used whenever the plant is referred to.

It has recently come into notoriety in Western Iowa as the cause of a fatal disease among horses, and to which the name of Crotalism has been applied by my colleague Dr. M. Stalker, the State Veterinarian. On this account I have deemed it to be of sufficient importance to merit a special popular description, so that it may be readily recognized by every one. The accompanying figure drawn directly from fresh specimens will aid still further in its identification.

The plant is an annual, growing each year from the seed and not living over winter. When full grown it is from a foot to a foot and a half in height, and is repeatedly branched. It is at first leafy from the ground up, but later its lower leaves wither and die, leaving the lower part of the stem naked.

Its *root* is simple, running down and gradually tapering as a sort of small tap-root, as shown in the accompanying figure. The root sends out numerous side rootlets, but these never attain so great a size as to obscure the main root itself.

The *stem* as mentioned above, is branched and is covered with whitish hairs. It is round, or roundish throughout, but here and there it has broad wings attached to it; these are narrow below and gradually broader above, as shown at *st* in the figure.

The *leaves* in the middle portion of the plant, where they are the best developed are from one and a half to nearly two inches long, and about one-third of an inch broad. They taper gradually towards each end so that their general shape is narrowly oval, with the ends quite pointed. They have a distinct midrib running from base to apex, and numerous small veins or ribs running from this towards the margin. The edge of the leaf is entire or but slightly wavy, and is fringed with whitish hairs, which are also found on both upper and under surfaces.

The *flowers* are small, being about one-fourth of an inch in diameter, and in form bear a pretty close resemblance to those of the common garden pea. They are of a decided yellow color, and



FIG. 1. THE RATTLEBOX, (*Crotalaria sagittalis* Linn.) a little less than natural size; showing at *r*, the root; at *gr*, the ground line; at *fl*, a flower; *p*, a young pod; *p2*, an old pod; at *p3*, a pod cut across to show the seed; at *s*, two seeds about twice the natural size; at *st*, a portion of the stem showing the wings; at *lf*, a leaf, natural size. (From drawings by the author.)

usually several of them grow near each other on a slender branch of the plant. The little leaves forming the base of the flower (the calyx) as well as the flower stalks are quite hairy.

The *Pods* also bear a resemblance to those of the garden pea. They are, however, smaller, although they are proportionately large when we consider the very small flowers from which they are developed. Full grown pods are from $\frac{3}{4}$ of an inch to an inch in length and are about one-third of an inch in diameter. They are nearly round in a cross section (as shown in the figure at p3), having a little crease along the upper side, and another along the lower. They are blunt at both ends, and have a small well defined hook or beak at the end opposite the point of their attachment to the stem. When young they are green and soft, but as they ripen they turn to a purple-black color and become hard and stiff. They are at all times perfectly smooth, having no hairs upon their surface.

The *seeds* are two or three times as large as pin-heads, measuring from one-tenth to one-twelfth of an inch in diameter. They are flattish, and irregularly rounded, having a notch or depression upon one edge (as shown in the figure at s.) When ripe their color is a rich brown, and their surfaces are smooth and shining. Before ripening they are attached to the upper side of the cavity of the pod in a double row, but when ripe they fall off and rattle about loosely in the stiff pod.

The Rattlebox grows throughout most parts of the Eastern United States, having been collected from New England to Florida on the east, to Iowa and Arkansas in the interior. It prefers sandy banks for its place of growth.

The earliest mention of this plant occurs in the writings of Linnæus, who described and named it from specimens sent him from the Atlantic coast sometime during the last century. Michaux a French botanist who travelled in this country eighty or ninety years ago notices it in his Flora. Pursh also describes it in his Flora in 1813; so does Nuttall in 1818, in his Genera of North American plants, Beck in 1833, Torrey and Gray in 1840, Darlington in 1853 and many other writers since have given botanical descriptions of the Rattlebox, but in no case whatever was there the slightest hint given of any deleterious principle possessed by it. I have, moreover, examined as much of the literature of "loco plants" as I have been able to secure and have here again found no reference to this plant as a source of any of the "loco" trouble. It may then be taken as certain that the Rattlebox has hitherto escaped suspicion.

In order that the reader may have before him a description of the disease, which the Rattlebox produces, I reprint here a report made by Dr. Stalker, which was first printed in the *Daily State Register*:

CROTALISM—A NEW DISEASE AMONG HORSES.

Some two months since repeated calls began to be made on my office through letters from various localities between Council Bluffs and Sioux City, for information concerning a highly fatal form of disease prevailing among the horses. These letters came from towns in Iowa, Nebraska, and Dakota, but in every instance from locations in the Missouri valley. I went out in answer to these calls and soon learned that the situation was one of sufficient gravity to justify alarm. After visiting a number of towns along the line of the Sioux City & Pacific railway, and making long excursions into the country, I gathered sufficient history to justify the estimate of fatal cases at several hundred.

The disease had been known in this region for three or four years, but had not until the present summer prevailed to such an extent as to attract general public attention. But now the loss in horse stock on some farms was not to be counted by hundreds, but by thousands of dollars. The disease proved to be one that had not hitherto come within the range of my experience, nor had I any information of anything exactly identical with it. I spent several days among the farmers on the Iowa side of the Missouri river, taking careful notes of the symptoms, and gathering the history of the progress of the disease. On some farms I found almost all the horses affected, and on others but a few individuals. Deaths were an almost daily occurrence, and the farmer who owned a large stock of horses did not know to-day whether he would have teams for his farm work a week later. The disease in most cases is very slow in its progress, but proving almost uniformly fatal after a number of weeks or months. There is a general decline of bodily vigor throughout this period, and the only abnormal symptom in many cases is that of marked emaciation and consequent weakness. Horses that have been kept at pasture through the summer, without work, and where the grass grew in the greatest abundance, were so thin in flesh that they walked with the greatest difficulty. A critical examination of many of these patients revealed nothing more than the conditions resulting from starvation. This was not uniformly the case. In a number of instances there was marked coma or stupor, the animal often falling asleep while eating. In some instances the animal would remain standing for a whole week, sleeping much of the time with head resting against some object. In a few instances the animals lost consciousness, and broke through fences and other obstructions. A number of diseased animals were placed at my disposal, and assisted by Dr. Fairchild and Dr. Milnes I made post mortem examinations of five subjects with the most perfect uniformity as to the lesions presented. In every instance there was marked hæmorrhagic effusions into the fourth ventricle, the liver and spleen were abnormally dense, the walls of the intestines were almost destitute of blood, and the stomach enormously distended with undigested food. The stomach with its contents in some instances weighed as much as seventy pounds. These post mortem conditions, together with the clinical symptoms led me to believe the animals were obtaining some poisonous principle with their food. The symptoms in some cases bore such a resemblance to those produced by eating *Astragalus mollissimus*, or "loco plant" of the Western plains, as to direct my investigations to that family of plants. A careful examination of the meadow and pasture lands was not rewarded by the discovery of a single "loco plant."

It took but little investigation, however, to find a closely related plant growing in great abundance, both in the meadows and pastures. This was

the *Crotalaria sagittalis*, or rattle-box. This is also known as the wild pea, and is accounted by many farmers as the best of forage plants. Knowing the bad reputation of some of its near relatives, I determined to make some experimental tests with the plant. I employed a boy to collect about thirty pounds of the green plants, which I brought with me on my return to the college. I procured a strong young horse, affected with incurable catarrh, and attempted to induce him to eat the plant. This he persistently refused to do, though I sharpened his appetite by a protracted fast. It is a matter of common observation that animals eat it with the greatest relish in localities where it grows. Failing to induce the animal to take the plant voluntarily I prepared a strong infusion, and by means of the stomach pump gave the preparation obtained from about ten pounds of the plant. In twenty minutes stupor began to ensue, the eyes were closed, the head was rested against the side of the box, the breathing became stertorous, and all the symptoms developed that were to be seen in the patients previously examined. At the end of six hours the stupor began to disappear, the eye began to regain its brightness and in another hour the horse began to eat. The following day, when he had apparently recovered from its effects, he was given half the quantity of the drug as on the previous day. In this instance the symptoms were developed much more rapidly, the animal became unconscious in a short time and died in an hour and a half. The post mortem revealed the same condition of the brain as in the cases examined in the western part of the State. I now resolved to make a second experiment, in which the animal should receive a small quantity for a number of days in succession. Having procured another subject for experimentation, and a bushel of mature fruit, or pods of the plant, I commenced on Sept. 5th to give daily the infusion obtained from about one quart of the pods. On the fifth day of the experiment the characteristic stupor came on. The animal rested its head against the box and slept while standing. The symptoms grew more marked till the thirteenth day of the experiment, when the animal died. The post mortem showed the same as in the other cases. These experiments leave no doubt in my mind that the trouble along the Missouri river is occasioned by the animal's feeding on this little plant. It is from eight inches to a foot in height, with branching stems bearing yellow flowers in July and developing large pods resembling the pea, but containing a number of black, hard seeds. It grows on sandy bottom land, and is very abundant in the meadows and pastures in portions of the Missouri bottom. It is seldom seen among the tame meadow grass in any considerable amount. It thrives best among the wild grasses. Animals, doubtless, eat it much more than formerly, when the wild pasturage was better than at present. Cattle sometimes, though not often, suffer in the same way as horses.

The first question the farmer is likely to ask, is: "What shall we do?" You cannot rely on drugs to cure the disease. You must prevent its appearance. Feed wild hay free from the poisonous plant, tame hay, corn fodder, sheaf oats, straw, anything but the wild pea. Plow up the land and put it in tame grass. The wild rye, which is taking much of the bottom land, is aggravating the disorder brought on by the rattlebox. By the proper cultivation you will get rid of both at once. Animals placed on good green pasture, or supplied with other nutritive food, free from the poison, will doubtless make slow recovery. Two ounces of Epsom salts, with two drachms of sulphate of iron and one drachm of nux vomica daily will tend to restore the tone of the system and promote digestion.

M. STALKER, B. Sc., V. S., State Veterinarian.

Ames, Iowa, Sept. 24th, 1884.

THE INJURIOUSNESS OF PORCUPINE GRASS.

(*Stipa spartea* Trin.)

This tall, harsh grass, which is common throughout the north-west, is well known to most farmers. It has long, rough leaves, which have little value as forage, and as the time for flowering comes on it sends up a stout stem bearing few leaves, and terminating in a loose head. The flowers have each a very long beard which is perfectly straight at first. This beard is attached to a chaff, which closely enwraps the slender grain and remains permanently in contact with it. Some months ago I published the following description in the AMERICAN NATURALIST, which it may be of interest to reproduce here, together with the cut kindly loaned by the publishers of that journal :

"The mature 'fruit' of this interesting grass consists of a narrow cylindrical grain (Fig. 3) about 1^{cm} long and 1^{mm} thick (2-5



FIG. 2. (1)—Entire "fruit" of porcupine grass, natural size, showing the twisted awn or beard. (2)—Lower portion of the same, enlarged. (3)—Grain of same, enlarged. (From drawings by the author).

inch and 1.25 inch). This is enclosed in the two hard, persistent palets, the larger of which bears a tough awn 12 to 16^{cm} ($4\frac{1}{2}$ to 6 inches) long (1). This larger palet completely encloses the smaller one, and at maturity it is quite difficult, with the naked eye, to make out its overlapping margins. Its lower portion is densely covered with stiff hairs (2), as is also the short pedicel upon which the whole flower rests. This pedicel is tapering, curved and greatly indurated, and at the maturity of the fruit it separates at its lower end from the rest of the axis. At its point of separation, which now becomes the lower end of the "fruit," it is very sharp, readily piercing clothing or even the skin of the back of one's hand. The hairs prevent the withdrawal of the point, and tend to cause it to enter more deeply.

The awn, which is at first straight, is channeled on two nearly opposite sides. Both the channels, as well as the general surface of the awn, are provided with short stiff hairs which act as barbs. At maturity the awns begin twisting throughout a little more than their lower half as shown in the figure (1), but the upper portion remains straight or nearly so, and soon becomes bent at nearly a right angle to the twisted part. This twisting facilitates the entrance of the barbed pedicel and palets into the soil, and, as lately pointed out, into the skins of sheep, dogs and other domestic animals. The greater weight of the lower end of the whole "fruit" makes it, before the twisting of the awn, an excellent dart, and on falling out of the glumes it invariably strikes point downwards."

My attention having been called to certain articles as to the injuriousness of the fruit or seed, so-called, of this grass, I published the following statement in the journal above named :

"Mr. R. M. Christy read a paper recently before the Linnean Society of London on the power of penetrating the skins of animals possessed by the seed of *Stipa spartea*. "Inquiry among butchers and others showed conclusively that large numbers [of these seeds] were often found beneath the skin of sheep, especially about the shoulders." This grass is abundant in the Mississippi valley (where it is known as Porcupine grass), and we have been familiar with it for years, but have never before heard of its penetrating the skins of animals. Has this been noticed by NATURALIST readers ?"

This brought out a number of replies among which were the following :

"You ask whether the fruits of porcupine grass (*Stipa spartea*)

are ever a source of inconvenience or injury to living animals? This may be very emphatically answered in the affirmative. In many of the northwestern counties of Iowa this grass grows in the greatest profusion, and during the latter part of June, the season for maturing and consequent falling of these spines, they are the occasion of much annoyance and in some instances the death of domestic animals. Only such animals as are covered with wool or a thick growth of long hair are seriously inconvenienced. Sheep suffer most. The spines readily find a lodgment in the wool, and after burrowing through it frequently penetrate the skin and bury themselves in the flesh. A large number of these barbs thus entering the tissues of the body produce an amount of irritation that is sometimes followed by death. I have seen large numbers of these imbedded in the skin and muscular tissues of shepherd dogs that were covered by a thick growth of soft hair. These sagacious animals frequently exhibit the greatest dread at being sent into the grass during the season of danger."—*M. Stalker, State Veterinarian.*

"In connection with the two notes relating to the fruit of the porcupine grass, it may not be without interest to state that while engaged in geological work in Dakota, north of the Northern Pacific R. R., we were much annoyed by the fruit of this grass. Indeed I found the only way to walk with comfort through this grass was to roll my pants above my knees and my socks down over my shoes.

I also observed, on several occasions, these seeds planted two inches deep in the soil with the awn protruding from the ground. It is plain that with the point of one of these fruits once entered below the surface of the soil the swelling and shrinking, due to varying amounts of moisture, would work the seed directly into the ground."—*F. H. King, River Falls, Wis.*

Fortunately for us this grass is very shy of the cultivator, and quickly disappears when the plow begins to stir the prairie soil. Already in Central Iowa it is becoming somewhat rare, and I predict that the day is not far distant when it will be scarcely known within the state.

THE WHEAT SMUTS.

There are at least two distinct diseases of wheat to which the name of Smut is popularly applied, although they can be readily distinguished by a little care in making examination of the heads. In

the one case the kernels only are affected, the interior of each being a black powdery mass, the skin of the grain being, however, intact. In the other case, not only are the kernels affected and entirely destroyed, but the chaff is also attacked, and all are reduced to a black powder which drops to the ground upon the lightest touch or is borne away by the gentlest breeze.

The first of these is

STINKING SMUT, OR BUNT.

(*Tilletia tritici* Winter.)

It is ordinarily spoken of as simply smut, and by this name the farmers and millers refer to it. It is always unfortunate when the same popular name is applied to different things, and in this connection it may be well to say that the misfortune is greatest for the people who use popular names alone. The scientific man has the technical name always at hand, and by this he is enabled to designate accurately the forms which are popularly confused. It would be well if the teachers of botany and agriculture in our Agricultural Colleges, and the editors of our agricultural papers could come to some agreement in the use of popular names, for until this is done there will always be a great deal of confusion in the reports and communications which have to deal with plants having these ambiguous names.

As the name "smut" is in this country so generally applied to the disease of wheat now under consideration it is undoubtedly well to retain it, but in order to designate it accurately it should be called "stinking smut," or if we wish an expression not quite so inelegant, we may say "fetid smut," names which refer to the stinking or fetid odor of the crushed kernels. In England the name "Bunt" is largely used, and so when English books are read it must be remembered that that name refers to the disease now under consideration. Indeed, I am not certain but that it might have been a better policy to have urged the adoption of the English name. The hopelessness of the task of introducing an entirely new name, however, is such that desirable as it may be, it must be abandoned.

This smut is a minute parasitic plant. If we could take it out from the wheat plant, it would be found to consist of a multitude of minute branching threads resembling, in some respects, the moulds which are so common in damp cellars and pantries. These threads penetrate the tissues of the stems of the wheat, and there

gather nourishment for their growth. They grow upward and finally reach the young wheat head where they ramify throughout the young kernels. The kernels become swollen, and are generally a little shorter than perfect wheat grains. They also take on a peculiar greenish cast, quite unlike the color of the grains which are free from disease. The whole head changes somewhat in its appearance (as shown in the figure) the beard and chaff spreading out

somewhat more than is natural in ordinary heads. The color, also, of the diseased heads, is different, being of that shade of green which can be best described as a greenish-lead color. Some years ago, when this disease was quite common, I found that by a little practice I could readily detect the smutted heads even at a distance of a few yards, by their form and color, and it would not have been a difficult matter to have plucked off all the diseased plants by walking regularly back and forth through the field taking a width of four or five yards.

To return now to the development of the parasite, it appears that the rich food it finds in the young wheat kernels stimulates it to produce spores (that is, reproductive bodies analogous to seeds). These spores form in such enormous numbers



FIG. 3.—Wheat head affected with stinking smut (*Tilletia tritici* Winter); *a* two diseased kernels; *b* the same split open. (From drawings by the author).

that the interior of the kernel soon is but a black mass of them, (as shown at *b* in the figure). If we place a little of the black powder from one of these kernels under a compound microscope we find

the spores to be globular, with their surfaces generally more or less regularly marked in a netted manner. These are the bodies from which the smut of the next year is to be produced. Minute as they are, they are for these parasitic plants what seeds are for the higher plants. The spores as stated above, have a fetid odor, which is as sickening as that of rotten eggs, and not very unlike the latter in quality, but not in quantity.

The spores, on account of their minuteness, readily adhere to the sides of the perfect wheat kernels; and especially are they found in the crease of the grain and the little tuft of hairs at the upper end. I have frequently examined kernels taken from bins in which smutted wheat was kept, and have invariably found the spores of the smut present in the situations described. Doubtless in this way the spores are carried into the new fields of wheat, for observation has shown that if *perfectly clean* seed be sown upon new ground there will be no smut. The spores have been studied during their germination, and it is known that under proper conditions of moisture and heat they will grow and produce threads; but the exact time or mode of entrance into the wheat plant has not been observed. That is, while the spores have been repeatedly seen to germinate, no one has yet been fortunate enough to witness the entrance of the parasite into the wheat plant. That it does enter there can be no doubt, as *we find it inside* of the wheat plant, but just where it crept in we have not yet found out. It is probable, however, that it entered low down on the wheat plant and when it was still quite young. The reasons for this conclusion may be seen from the following observations made in the year 1872, and since repeatedly verified.

TABLE I.

PLANT.	NUMBER OF STEMS PER PLANT.	REMARKS.
1.	Three stems.	All affected.
2.	Three "	All affected.
3.	Two "	One certainly affected, the other one which is young and in flower has an appearance as if the tissues were somewhat disorganized.
4.	Three "	All affected.
5.	Two "	Both affected.
6.	Two "	Both affected.
7.	Three "	Two certainly affected, in the other no smut evident, perhaps on account of its being quite too young.
8.	Two "	Both affected.
9.	Three "	All affected.
10.	Two "	Both affected.
11.	Three "	All affected.

The law, which is very evident from the foregoing observations is clearly that the whole plant, or, as the farmers say, the whole "stool" is affected. Now if we examine one such "stool" we find this condition of things : 1st, the wheat plant when it first starts is simple, that is, it has but one stem : 2d, after a while this simple stem sends out, just at the ground, one or more branches, that is what we call "stooling," and upon the amount of this very much depends as to the abundance of the crop. A common wheat plant at the time of heading is thus a branching plant, the branches starting out very low down. Now it is clear that the probabilities are that any disease affecting all the branches must have originated low down in the plant, and moreover quite early in its life.

Any attempt to combat this disease must be in the nature of prevention. When once the disease has a foothold it appears to be absolutely incurable, and any time or money spent at this stage will be thrown away. It will do no good, whatever, to go over the field after the heads appear, and hope by any application, as by the sowing of this or that nostrum to check the progress of the disease, nor can any application at this stage of the crop prevent the appearance of smut. Preventive measures at this stage come too late.

It has been demonstrated over and over again that perfectly clean seed and clean ground will produce a clean crop. It is with smut as with weeds of all sorts, if we have seeds we shall have weeds growing up as a result, but if we have no seeds there will be no weeds. So with smut, clean seed upon a clean field will result in a clean crop.

Never allow a second crop to immediately follow a smutted crop of wheat ; just how great a length of time ought to intervene has not been certainly determined. It would be much safer to allow several years, however, and it would be still better to have the soil stirred frequently as by planting a cultivated crop like corn or potatoes.

Sow only perfectly clean seed, and if that is not possible, thoroughly wash the seed in large tubs or troughs of water, as in this way the unbroken smutted grains will be floated out on account of their superior lightness, and besides, many of the spores adhering to the perfect grains will be washed away. These adhering spores may be pretty thoroughly killed by soaking the wheat for a little while in a solution of "Bluestone" (Sulphate of Copper). It should be borne in mind, however, that in any attempt to purify smutted seed the probabilities are that you will not remove or destroy all the smut

spores. Hence it is the better policy to purchase seed which is known to be clean.

BLACK SMUT.

(*Ustilago segetum* Winter.)

I have heard the names of Black Blast or Black Blight applied to this smut, and to these there can be but little objection. However, as it is a smut it will be, all things considered, better to call it by the name at the head of this paper, viz., Black Smut.

This smut is much more obvious than the preceding one, and may be noticed at once in the field. Its general appearance is well shown in the accompanying figure, which will be recognized by every grain grower. It is not confined to wheat, but is very common on oats and barley, upon both of which crops it produces a good deal of loss.

The life-history of Black Smut is very much like that of Stinking Smut. It doubtless gains entrance to the plant while the latter is still quite young, although from observations I have made I should say that in all probability the entrance may be later in some cases. There is by no means that uniformly general disease of the "stools" as is shown by the following tables of observations made in different years.



FIG. 4. Head of wheat affected with Black Smut, (*Ustilago segetum* Winter.) Six spores are shown magnified at the right. (From drawings by the author.)

TABLE I.

PLANTS.	NUMBER OF STEMS TO EACH PLANT.	REMARKS.
1.	Two stems,	Both smutted.
2.	Two "	Both smutted.
3.	Two "	Both smutted.
4.	Four "	Two smutted, two not.
5.	Two "	Both smutted.
6.	Seven "	Five smutted, two not.

TABLE II.

PLANT.	NUMBER OF STEMS TO EACH PLANT.	REMARKS.
1.	4 strong stems and 2 weak ones.	Three smutted, three not ; one of the weak ones smutted, one not.
2.	Sixteen stems	Four smutted, twelve not.
3.	Two "	Both smutted.
4.	Three "	Two smutted, one not.
5.	Three "	All smutted.
6.	Five "	All smutted.
7.	Two "	One smutted, one not.
8.	Four "	All smutted.
9.	Four "	All smutted.
10.	Three "	Two smutted, one not.
11.	Five "	All smutted.
12.	Four "	All smutted.
13.	One "	Head smutted for about one-third of the way from below upward, while the upper part of the head appeared to be in the usual healthy condition.

It is clear from the foregoing results that smut is a general disease in wheat plants, that is, that for the most part it affects the whole plant, invading all its stems, and as shown in the case of the stinking smut, the fact that these stems all start out near the ground suggests the probability that the disease began in the early stages of the wheat plant and grew out into its branches as they developed. A recent writer, Mr. Worthington G. Smith, in a valuable little book on the "Diseases of Field and Garden Crops," concludes that the parasitic threads "find their way into the earliest produced stomata [that is the breathing pores] of the infant plant," thus confirming the views here and heretofore set forth.

The spores of this smut are very minute, being much smaller than those of the stinking smut. Their minuteness enables them to be blown hither and thither upon the lightest breeze. An idea of their extremely small size may be gained by using the illustration of the author just quoted above, who says of them "that it would take nearly 25,000,000 of them to cover a superficial square inch." There are probably a score of millions, or so, in each infected wheat kernel, and in an ordinary head, such as that shown in the figure given above, there must be from half a billion to a full billion of spores. What wonder then, that smut is propagated freely year by year. The only wonder is that it does not entirely take possession of

our crops. If you will make a little calculation you will readily see that one smutted head produces spores enough, were none lost, to infect every wheat plant in a five hundred acre field. Calculations like these show us why these pests are so hard to be gotten rid of.

As to the amount of loss from this fungus I can not do better than to quote from a recent bulletin issued by Dr. Sturtevant, the director of the New York Agricultural Experiment Station. The observations there recorded were made upon oats which is perhaps a little more subject to black smut than wheat is, but still the lesson taught is exactly the same, that is that it does not pay to allow smut to grow in one's crop, if it can be helped.

"It is usually a difficult matter to arrive at any accurate estimate of the loss produced by fungi. The loss is sometimes so great as to cause the total destruction of the crop, but more often is an indefinite portion, very difficult to express in figures. In many instances it is looked upon as an inevitable accompaniment of cultivation, varying according to the season and therefore to be taken as a matter of course.

Probably no fungus will better illustrate the points we wish to bring out than the smut of grain (*Ustilago segetum*). When it attacks a plant, the whole head or panicle is turned to a black powder and destroyed. By counting the number of healthy and of smutted culms over a certain area, we arrive at a perfectly accurate and just estimate of the loss produced by the smut. The following table shows the results of counting the culms of oats in eight as widely separated areas as possible upon the Experimental Farm. Number 1 and 2 were growing in the experimental plats, the others in different parts of the fields.

Variety	Sq. feet of ground.	Height of culm	Number of culms.	Per cent. smutted.
1 American Triumph-----	132	44 inches	1237	10.
2 Board of Trade-----	132	48 "	2353	8.5
3 New Australian-----	40	30 "	892	10.3
4 " "-----	53	46 "	1397	7.
5 " "-----	40	46 "	1088	9.2
6 " "-----	40	36 "	1315	15.
7 " "-----	60	56 "	1748	7.5
8 " "-----	46	48 "	1183	10.2
Total-----	544		11213	9.5

The total area of the two square rods embraced every variation of soil and crop the farm afforded, and it is not believed the counting of a greater area would have materially affected the result. There was no greater appearance of smut as one passed through the field than is usually to be seen in any part of the country, at least east of the western plains, and the result of the count, showing a total loss of 9½ per cent. of smutted grain, is as much a surprise to the writer as it will doubtless be to others. The apparent strength of the yield in the various areas was in about the relation indicated by the height of the culms, showing that the lightest oats smutted the worst. Number 6, which gave 15 per cent. of smut, grew on the edge of a steep bank, where it was particularly dry, while number 7, giving almost the lowest per cent. grew very rank on low rich land."

Now what shall be done with this destroyer? How shall we avoid the heavy tax of nine and a half per cent? In the same bulletin quoted from we find a suggestive paragraph as follows:

"It should be mentioned here that the thirty varieties of oats growing in the experimental plots were very unevenly affected by smut, some having almost none, the reason for which was not apparent."

The varieties which are less affected are named in a subsequent bulletin as follows:

"*Smut* was also quite prevalent, although some varieties were not affected, though growing side by side with varieties badly infected. The black oats were absolutely free from smut, while growing beside them on one side was the American Triumph, of which plants 10 per cent. were smutty, while on the other side grew the Board of Trade, even smuttier than the American Triumph. The two varieties most affected by smut were White Australian and Board of Trade, the former containing nearly twice as many smutty heads as any other, with the exception of Board of Trade. Those not at all affected were Black Champion, Black Tartarian, Pringle's Excelsior Hulless, Pringle's Hybridized Hulless, Mammoth Russian, Mold's Ennobled and Race Horse."

Worthington G. Smith in his book (p. 261) says: "A remedy against smut much in favor in the north of England, and one which is said to never fail, is the preparation of the seed, immediately before sowing, with a sprinkling of stale urine, the seed being afterwards raked in powdered quicklime till the seed is white. Sometimes the seed is prepared with vitriol or sulphate of copper or 'bluestone' dissolved in boiling water. One pound of bluestone dissolved in five quarts of water is sufficient for a sack of four imperial bushels. The wheat is soaked for ten minutes, or the ten pints of solution may be poured over till all is absorbed."

THE SMUT OF INDIAN CORN.

(*Ustilago zeæ-mays* Winter.)

This pest of the cornfields merits a few pages in this Bulletin, as it annually causes considerable losses to every corn-growing



FIG. 5. Smut on part of an ear of Indian Corn: At the right is shown a smutted kernel cut through to show the interior (From Figuler.)

farmer in the state. It varies much in its abundance year by year, sometimes being scarcely noticeable, while at other times it is so abundant as to injure or destroy fully fifteen per cent. of the ears. A few years ago I observed one piece of ground upon which fully two-thirds of the ears (sixty-six per cent.) were entirely destroyed by smut.

This smut, like those which affect wheat, is a minute parasitic plant, composed of excessively small threads which penetrate the tissues of the corn. We are met herè by the same difficulties en-

countered in the previous cases, and have been unable to make out the way that the parasite gains entrance to the corn plant.

Everything, however, points to the probability that it enters while the corn is still small, for the parasite has been observed in the lower joints of the corn-stalks, and this could scarcely have been the case had its entrance been after the corn had attained a considerable size or age.

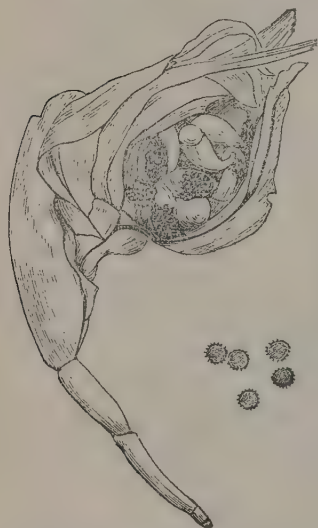


FIG. 6. A smutted ear of corn in the author's possession. At the right are five spores highly magnified. (From a drawing by the author.)

microscope, it will be found to consist of myriads of globular spores covered with minute prickles (as shown in Figure 6). If we compare them with the two smuts of wheat we observe that the spores of this corn smut are larger than those of the Black smut, but smaller than those of the Stinking smut. Indeed it is not at all difficult to distinguish them from one another in the field of the microscope.

That the spores reproduce the smut there can be no doubt when we consider their structure, and the relation that spores always have elsewhere among the fungi. So that we are prepared to advise the careful gathering and burning of all the smutted ears in the field. The gathering should be done early in order that the spores may not be scattered upon the ground before or during the removal of the affected ears. Moreover, it should be remembered that in some seasons this smut is found, not only on the ears, but also in

As in the previous cases, the parasite produces its spores for the most part on or near the young kernels, which are as a consequence greatly distended and distorted. Every farmer has seen the thick growths which occupy the places on the ear which should have been filled by the sound kernels. At first they are white within, but a little later they turn dark and become very wet and slimy from the melting of the parasitic threads. If at this time a bit of this slimy mass be placed under a compound

the tassels, and upon the leaves, and even bursting out from the stems. All such affected parts should be gathered and burned.

Now, it may be said that the farmer cannot afford the time and money necessary for such work, and I well know that there are already so many things to be done by the tired and overworked tiller of the soil that any advice which implies or calls for more work seems heartless; but, where a little extra labor will add to the profits of the crop, that labor should be undertaken. Let us make a little calculation upon this matter: Take a forty acre field of corn, which should produce at least eight hundred dollars worth of corn. It is rarely the case that the loss from smut is not fully one ear for each square rod. Yet this low loss would amount to about two per cent. upon the whole crop, that is *sixteen dollars for the whole field!* Much more commonly there are several smutted ears for each square rod. Two smutted ears per square rod represents a loss of thirty-two dollars; three smutted ears a loss of forty-eight dollars, and so on. Certainly these are losses which it is well worth the while of any man to avoid.

Now the cost per annum of gathering and burning the smutted ears ought not to exceed ten or fifteen cents per acre, that is four to six dollars for the forty acres. A smart boy carrying a bag slung over his shoulder ought to be able to earn good wages in "smutting" corn at ten cents per acre.

But the question is asked, will it do any good to gather up the smutted corn? Will it not be only so much expense to be added to the loss already suffered? To this I answer confidently that if the work is properly done every farmer can in the course of a couple of years almost or entirely rid his field of smut.

Smut can not develop if there have been no spores. If the spores are annually destroyed, *all of them*, there can be no smut the next year, but if the gathering be delayed until the spores fall out in a cloud of dust when the smut is gathered, then burning will do little good, for in such cases the spores are *not all burned*.

THE ERGOT.

(Claviceps purpurea Tul.)

There are few farmers who have not noticed the large black grains or spurs which sometimes appear in the heads of rye, taking the place of the proper rye grain. The accompanying figure represents such an affected rye head, there being two of these black grains present. Very often there are half a dozen or more, some being smaller than those shown, while I have often found them nearly twice as large. Observation has shown that stray clumps of rye which have sprung up from seed accidentally scattered by the roadside or in neglected places are much more subject to this trouble than the rye in the field. Why this is so, I can not now explain.

These black grains have been known for a long time by the name of Ergot, and, moreover, it has been for many years well known to be due to a parasitic fungus.

Ergot contains a poison, which has a powerful action on the animal body, and on that account it has been made use of in medicine. The medical books contain full descriptions of these actions, and I need not repeat them here; it will be sufficient to say that one of its actions, is such as to produce abortion in pregnant animals, while another is of such a nature as to produce gangrenous sores upon the body, especially upon the extremities. This last result has been called *Ergotism*, and in one instance, at least, (in Kansas late last winter) it was so prevalent and so injurious among cattle that for a time it was thought that there had been an outbreak of the "foot and mouth disease." These facts warrant me in describing this fungus with some care.



FIG. 7. The Ergot (*Claviceps purpurea* Tul.) on a head of rye. (From Luerssen.)

The first appearance of ergot is to be noticed when the grain is quite young. It is then a whitish mould-like growth creeping over the young grain and penetrating its tissues. The grain soon begins to shrivel under the attacks of the fungus. At this stage the fungus produces myriads of excessively minute spores (analogous to seeds) which are readily blown from grain to grain and head to head, where they quickly germinate and produce more ergot. In this way from a few infected heads the disease may spread until it involves great numbers.

After the spores are produced, the fungus begins a rapid growth at the base of the now shriveled grain, and soon there is formed the dark colored body, so well shown in the figure. There may still be seen at the top of each ergot grain a portion of the old and shriveled up rye kernel. The fungus now ceases its growth; and is now ready to endure the drouth of the autumn and the cold of the winter. The ergot of rye generally falls out and passes the autumn and winter upon the ground, but the ergots of some of our grasses appear to remain in connection with the plant for a much longer period.

This black spur-like ergot is a resting stage of the fungus. It rests just as a potato tuber does, or as an onion bulb, and like them when good conditions appear, it renews its growth. This takes place in the spring upon the damp ground. The result of this growth is that in a little while a great many spores are produced, and by these new ergot may be produced. Thus the black ergot grains of one year become the means for producing more ergot the next year.

Ergot occurs not only on rye, but also upon many of the grasses used for hay or pasture. I have repeatedly observed it on common Blue Grass (*Poa pratensis*); but here, on account of the smallness of the flowers and grains, the ergot is not above a quarter of an inch long, and is but little thicker than a pin. It is, however, of the same shape and in every other respect, except as to size, it is exactly like that on rye. I have known of cases of disease in cattle (ergotism) which were due to the ergot on Blue Grass.

Ergot also occurs abundantly on the large wild grass known as Wild Rye (*Elymus canadensis*), and here it attains a size almost if not quite equal to that on ordinary rye. As this grass is very frequently cut for hay on the prairies, the presence of ergot in its heads may become a source of great danger. It appears that the recent outbreak of ergotism in Kansas, referred to in the beginning

of this paper was due to ergot on Wild Rye. Specimens of the hay grasses were brought to me from the infected region by Dr. Stalker and I found, on examination that the Wild Rye, which constituted a considerable portion of the hay, was badly affected, many of the heads containing half a dozen or a dozen large and well developed ergot grains.

I have now and then observed ergot on Timothy (*Phleum pratense*), but so far as I am aware it is never abundant enough to become a source of danger.

PART II.

PRELIMINARY LISTS CRYPTOGRAMS,

Including (1st) lists of those which have been identified as occurring within the Ames Flora, that is, within a radius of twenty miles of the Iowa Agricultural College, and (2d) lists of the Rusts and Smuts of the whole state.

PRELIMINARY LIST OF PROTOPHYTES OF THE AMES FLORA.

CLASS I. THE SLIME MOULDS (*Myxomycetes*).

Order Calcareæ

BADHAMIA HYALINA Berk. ? On decaying bark of Box Elder.

PHYSARUM POLYMORPHUM (Mont) Cooke. On decaying bark of Box Elder.

PHYSARUM SINUOSUM Rtfki. On mosses in the woods.

FULIGO VARIANS Rtfki. Common on decaying wood and bark. I have found it growing out from a rotten railroad tie.

CRATERIUM LEUCOCEPHALUM Ditm. On dead sticks, twigs, leaves, etc., (and living leaves also) under evergreens, as spruces, pines, etc.

DIDYMIUM SP.

SPUMARIA ALBA D. C. Common upon grass, leaves and twigs.

SPUMARIA SP. On old horse dung. Smaller and more compact than the two preceding species.

Order Amaurochætææ.

COMATRICHA PULCHELLA Rtfki. On decaying bark of Box Elder.

STEMONITIS FUSCA Roth. On old rotten wood.

STEMONITIS FERRUGINEA Ehr. On rotten logs.

Order Heterodermææ.

DICTYDIUM CERNEUM Nees. On rotten wood among mosses.

Order Columelliferææ.

RETICULARIA LYCOPERDON Bull. On stove-wood in a wood pile.

OPHIOTHECA UMBRINA B. & C. On bark of wood in wood pile.

Order Calonemææ.

ARCYRIA STRICTA Rtfki. On old logs.

ARCYRIA NUTANS Bull. On rotten stumps.

TRICHIA FRAGILIS Sow. On rotten wood.

HEMIARCYRIA RUBIFORMIS Rtfki. On old logs.

CLASS II. YEAST PLANTS AND BACTERIA. (*Schizomycetes*).

Order Saccharomycetes.

SACCHAROMYCES CEREVISIÆ Meyen. The Yeast Plant, which produces the fermentation of yeast. Other species scarcely distinguishable, occur in the fermenting juices of decaying fruits and vegetables.

SACCHAROMYCES ELLIPSOIDEUS Reess. In decaying grapes.

SACCHAROMYCES APICULATUS Reess. In decaying grapes.

Order Bacteriaceæ.

MICROCOCCUS PRODIGIOSUS Cohn. On articles of food, forming red patches.

MICROCOCCUS LUTEUS Cohn. On articles of food (boiled potatoes, etc.), forming yellow patches.

MICROCOCCUS UREÆ Cohn. In stale urine.

MICROCOCCUS CREPUSCULUM Cohn. In putrid water.

MICROCOCCUS VACCINÆ Cohn. In vaccination pustules.

MICROCOCCUS DIPHtherITICUS Cohn. In the mucus from the throat of persons suffering from diphtheria.

MICROCOCCUS SEPTICUS Cohn. In the pus of wounds.

In this connection it may be well to note that according to Dr Burrill the following species produce the diseases named in each case.

MICROCOCCUS Suis Burrill. In the blood of pigs suffering from swine plague or "hog cholera."

MICROCOCCUS INSECTORUM Burrill. In the digestive organs of chinch bugs.

MICROCOCCUS AMYLOVOROUS Burrill. In "blighted" twigs of apple and pear trees.

BACTERIUM TERMO Dujard. In putrid water.

BACTERIUM LINEOLA Cohn. In putrid water.

BACILLUS SUBTILIS Cohn. In putrid water.

BACILLUS TREMULUS Koch. In the surface slime of putrid water.

We may properly mention here that the following species produce the disease named in each case.

BACILLUS ANTHRACIS Cohn. In the blood of animals suffering from anthrax (splenic fever).

BACILLUS TUBERCULOSIS Koch. In the sputa of persons suffering from consumption.

LEPTOTHRIX BUCCALIS Robin. In decaying teeth.

LEPTOTHRIX PARASITICA Kutz. Attached to fresh water plants, as Green Felts, *Cedogonii*, etc.

SPIROCHÆTE PLICATILIS Ehrb. In stagnant water.

SPIRILLUM RUGULA Winter. In stagnant and putrid water.

SPIRILLUM UNDULA Ehrb. In stagnant and putrid water.

CLASS III. THE GREEN SLIMES. (*Cyanophyceæ*)*Order Chroococcaceæ.*

- CHROOCOCCUS REFRACTUS Wood.
GLÆOCAPSA SP.
CLATHROCYSTIS ÆRUGINOSA Hnfy.
MERISMOPEDIA NOVA Wood.

Order Nostocaceæ.

- NOSTOC SPHÆRICUM Vauch.
NOSTOC CÆRULEUM Lingb.
NOSTOC COMMUNE Vauch.
NOSTOC SP. Other species have been observed but not determined.

Order Oscillariaceæ.

- OSCILLARIA IMPERATOR. Wood. Common.
OSCILLARIA LIMOSA Ag.
OSCILLARIA NIGRA Vauch.
OSCILLARIA SP. Very small, almost colorless filaments. Common.

Order Rivulariaceæ.

- GLOIOTRICHIA SP.
RIVULARIA CARTILAGINEA Wood? On leaves and stems of water plants.
LIMNACTIS SP.
MASTIGONEMA ELONGATUM Wood?

Order Palmellaceæ.

- PLEUROCOCCTUS VULGARIS Mel.
TETRASPORA LUBRICA Ag. Floating in ditches.

Order Protococcaceæ.

- PROTOCOCCTUS VIRIDIS Ag. Very common on the moist surfaces of tree trunks, walls, etc.
CHLOROCOCCUM SP.
SCENEDESMUS QUADRICAUDA Breb.

PRELIMINARY LIST OF ZYGOPHYTES OF THE AMES
FLORA.

CLASS ZOOSPOREÆ.

Order Pandorineæ.

PANDORINA MORUM Bory. With other fresh-water sea-weeds.

GONIUM PECTORALE Mull.

Order Pediatreæ.

PEDIASTRUM BORYANUM Menegh. With other fresh-water sea-weeds.

Order Confervaceæ.

CONFERVA SP. Several species of Conferva are very common in the waters of the ponds and ditches about the college.

CLADOPHORA GLOMERATA Linn. Common in streams.

CLADOPHORA FRACTA Dillw.

ULOTHRIX SP.

DRAPARNALDIA PLUMOSA Ag. Floating in running brooks.

CLASS II. (*Conjugatæ.*)*Order Desmidiaceæ.* The Desmids.

Desmids are of rare occurrence in this flora. This is doubtless due to the fact that there are scarcely any permanent bodies of water in which they can vegetate. All the ponds and most of the streams dry up entirely in periods of drouth. The following are occasionally found.

CLOSTERIUM MONILIFERUM Ehrb. This large green, lunate desmid is the most common, but even it is not found in abundance. It occurs in ponds and slow streams and brooks mixed with other fresh-water algæ.

COSMARIUM MARGARITIFERUM Menegh? A small desmid resembling Wolle's figure and description of this species has very rarely been observed.

ARTHRODESMUS SP. Rarely observed; the species not determined.

MICRASTERIAS SP. Rarely observed; the species not determined.

Order Diatomaceæ. The Diatoms.

The Diatoms are abundant in the ponds, brooks, and ditches but no attempt has yet been made to identify the species. The following genera occur:

CYMBELLA.

NAVICULA. We have among our species what I take to be *N. VIRIDIS* Kutz, and *N. NOBILIS* Kutz., the latter a very large and striking species. Certain very small species are very abundant in early spring forming a dark yellowish-brown slimey coating on sticks and twigs in running water.

PLEUROSIGMA. Species of this beautiful genus are found occasionally, although they are by no means abundant.

GOMPHONEMA. These are abundant in our waters, especially in early spring, when forms closely resembling *G. CONSTRICTUM* Ehr., and *G. ACUMINATUM* Ehr., (if, indeed, they are not these species) are very common.

SYNEDRA. Certain very slender diatoms which are abundant in mid-summer are referred to this genus.

FRAGILARIA. Several species of this genus occur in our waters forming long ribbons, often containing hundreds of individuals.

COSCINODISCUS. The diatoms of this genus are circular in outline. They are very rare in our waters, having been found but a few times.

Order Zygnemaceæ. The Pond Scums,

SPIROGYRA PROTECTA Wood.

SPIROGYRA LONGATA Ktz.

SPIROGYRA QUININA Ktz.

SPIROGYRA MAJUSCULA Ktz.

This last species was observed in the autumn of 1883 in conjugation with *S. protecta*. the result of the union being a hybrid resting-spore which bore some resemblance to that of both species. (See AMERICAN NATURALIST, Vol. XVIII, p. 67.)

ZYGNEMA INSIGNE Ktz.

ZYGOGONIUM SP.

MESOCARPUS SCALARIS Hass?

Order Mucorini. The Black Moulds.

MUCOR STOLONIFER D. By. The common Black Mould of bread, pastry, etc.

MUCOR SYZYGITES D. By. On decaying toad-stools and pore-fungi.

PILOBOLUS CRYSTALLINUS Tode. On horse dung. Very common in midsummer and autumn.

PRELIMINARY LIST OF OOPHYTES OF THE AMES
FLORA.

CLASS I, ————— (Zoosporeæ.)

Order Volvocineæ.

VOLVOX GLOBATOR Linn. Rarely found.

CLASS II, ————— (Ædogoniææ.)

Order Ædogoniææ.

ÆDOGONIUM LONGATUM Kutz. This minute species which is attached to the sides of larger plants is our most abundant species. The oospore is terminal, and the oogone is apiculate.

ÆDOGONIUM INEQUALE Wood? With other aquatic plants; not common.

ÆDOGONIUM SP. A large thick walled species is occasionally found. It is much larger and heavier walled than any species of which I have descriptions.

CLASS III, ————— (Cæloblastææ.)

Order Vaucheriaceæ. The Green Felts.

VAUCHERIA SESSILIS D. C. Common.

VAUCHERIA GEMINATA D. C. Common.

VAUCHERIA TERRESTRIS Lyngb? A small species found on the ground, I take to be this species.

Order Botrydiaceæ

The position of this order here is doubtful. It is represented in our flora by one known plant.

BOTRYDIUM GRANULATUM L. On damp earth in the autumn, forming a green granular coating.

Order Saprolegniaceæ. The Water Moulds.

SAPROLEGNIA FERAX Ktz. On dead fishes, cray-fishes, etc., floating in the water.

ACHLYA PROLIFERA Nees. On decaying flies in the water.

Order Chytridiaceæ.

CHYTRIDIUM SP. In cells of fresh water algæ.

OLPIDIUM SAPROLEGNIE BRAUN. In the terminal cells of Achlya.

SYNCHITRIUM FULGENS Schroter, var. DESCIPiens Farlow. Common on stems and leaves of Amphicarpæa.

Order Entomophthoræ, The Insect Fungi.

ENTOMOPHTHORA MUSCÆ Fres. The Fly Fungus. Very common on flies in autumn causing them to swell up and die.

ENTOMOPHTHORA CALOPTENI Bessey. This fungus is parasitic upon locusts ("grasshoppers") in the autumn. (See AMERICAN NATURALIST Vol. XVII. 1883, p. 1280.)

Order Peronosporæ. The Mildews.

PERONOSPORA VITICOLA D. By. The Grape Mildew. Common from midsummer to Autumn on leaves and young twigs.

PERONOSPORA HALSTEDI Farlow. On many composites.

PERONOSPORA OBDUCENS Schr. On Wild Touch-me not.

PERONOSPORA GERANII Pk. On wild Geranium.

PERONOSPORA PYGMEA Unger. On wild Anemones.

PERONOSPORA GANGLIFORMIS D. By. On wild Lettuce.

PERONOSPORA PARASITICA Tul. On various Crucifers.

PERONOSPORA POTENTILLÆ D. By. On Potentilla in the autumn.

PERONOSPORA ARTHURI Farlow On Evening Primrose.

PERONOSPORA EFFUSA Rabh. On Chenopodium.

PERONOSPORA ALTA Fkl. On Plantain.

PERONOSPORA TRIFOLIORUM D. By. On Wild Vetch (*Vicia americana*.)

PERONOSPORA LEPTOSPERMA D. By? On Wild Sage (*Artemisia*).

CYSTOPUS CANDIDUS Lev. The White Rust of many Crucifers.

CYSTOPUS BLITI Lev. On Pig-weed (*Amarantus*.)

CYSTOPUS PORTULACÆ Lev. On Purslane.

PRELIMINARY LIST OF CARPOPHYTES OF THE AMES
FLORA.CLASS I.....(*Coleochæteæ*.)

COLEOCHÆTE SP. Specimens of a Coleochæte were collected some-
years ago but the species was not identified.

CLASS II, THE RED SEAWEEDS (*Florideæ*.)

No members of this class have as yet been collected in the state.

CLASS III, THE SAC-FUNGI (*Ascomycetes*.)*Order Perisporiaceæ.* The Blights.

PODOSPHERA TRIDACTYLA D. By. Abundant on the leaves of seed-
ling cherries and apples.

SPHEROTHECA PANNOSA Lev. On Wild Gooseberries.

SPHEROTHECA CASTAGNEI Lev.

PHYLLACTINIA SUFFULTA Sacc. On leaves of many trees.

UNCINULA ADUNCA Lev. On willow leaves.

UNCINULA AMPELOPSIDIS Peck. On Virginia creeper leaves.

UNCINULA AMERICANA Howe. On grape leaves and pedicels.

UNCINULA CIRCINATA C and Pk. On Silver Maple leaves.

MICROSPHERA RUSSELLII Clint. On Oxalis leaves.

MICROSPHERA EXTENSA C. and Pk. On Red-oak leaves.

MICROSPHERA FRIESII Lev. On Lilac leaves.

MICROSPHERA SYMPHORICARPI Howe. On Symphoricarpos.

ERYSIPHE LAMPROCARPA Lev. On many composites.

ERYSIPHE TORTILIS Fr. On leaves of Virgin's Bower.

ERYSIPHE COMMUNIS Fr. On leaves and stems of Anemones, also on
grass leaves.

ERYSIPHE MARTII Lev. On cultivated Peas.

EUROTIIUM HERBARIORUM Lk. On mouldy books, papers, herbarium
specimens, etc.

Order Tuberaceæ.

PENCILLIUM GLAUCUM Grev. On Decaying fruits, etc.

Order Helvellaceæ. The Cup Fungi.

MORCHELLA ESCULENTA Pers. The Morel. Common in moist
woods.

HELVELLA SP. One or more species of Helvella have been observed,
but not specifically identified.

PEZIZA TUBEROSA Bull. On the ground in the woods.

PEZIZA GRANULATA Bull. On a damp wall in the Main College building, and on earth in flower pots.

PEZIZA COCCINEA Jacq. In woods.

PEZIZA VULGARIS Fr. In hot beds.

CROUANIA MINIATA Fkl. On ground in the woods.

ASCOBOLUS FURFURACEUS Pers. On cow dung.

BULGARIA SP. On rotten logs.

STICTIS SP. On wood.

EXOASCUS DEFORMANS Berk. Parasitic on peach leaves.

EXOSACUS PRUNI Fkl. Parasitic on plum leaves and twigs.

PHACIDIUM REPANDUM Fr. Parasitic on the leaves and petioles of *Potentilla*.

RHYTISMA ACERINUM Fr. Parasitic on maple leaves.

Order Pyrenomycetes. The Black Fungi.

TORRUBIA RAVENELII Berk. Parasitic on the larvæ (white grubs) of May-beetles.

CLAVICEPS PURPUREA Tul. The Ergot of Rye, Wild Rye, Blue grass, Timothy, etc.

EPICHLÖE TYPHINA Berk. On grass stems.

NECTRIA CINNABARINA Fr. On dead twigs.

NECTRIA COCCINEA Fr. On fallen twigs of Norway spruce.

XYLARIA SP. On stumps and logs.

HYPOXYLON SP. On dead trees.

DOTHIDEA GRAMINIS Fr. On grass leaves.

PHYLLACHORA TRIFOLII, Fkl. On living clover leaves.

DIATRYPE QUERCINA Tul. On oak bark.

VALSA SP. Many specimens of this genus have been observed but not specifically identified.

CUCURBITARIA SP.

FLOWRIGHTIA MORBOSA Sacc. The Black Knot of the plum.

Order Lichenes. The Lichens.

RAMALINA CALICARIS Fr., var. FRAXINEA Fr.

RAMALINA CALICARIS Fr., var. FASTIGIATA Fr.

USNEA BARBATA Fr., var. FLORIDA Fr.

THELOSCHISTES POLYCARPUS Tuck.

THELOSCHISTES CONCOLOR Tuck.

PARMELIA PERFORATA Ach.

PARMELIA TILIACEA Floerk.

PARMELIA BORRERI Turn.
 PARMELIA CAPERATA Ach.
 PHYSCIA SPECIOSA Nyl.
 PHYSCIA STELLARIS Tuck.
 PHYSCIA OBSCURA Nyl.
 PELTIGERA POLYDACTYLA Hoffm.
 LEPTOGIUM TREMELLOIDES Fr.
 PLACODIUM AURANTIACUM N & G.
 LECANORA SUBFUSCA Ach., var. ARGENTATA Ach.
 PERTUSARIA VELETA Nyl.
 CLADONIA PYXIDATA Fr.
 CLADONIA FURCATA Fr.
 CLADONIA FURCATA Fr., var. SUBULATA Fr.
 CLADONIA MACILENTA Hoffm.
 CLADONIA CRISTATELLA Tuck.
 GRAPHIS SCRIPTA Ach.
 ENDOCARPON PUSILLUM Hedw.

*Order Uredineæ. The Rusts. **

UROMYCES ACUMINATUS Arth. On Cord grass.
 UROMYCES BRANDEGEI Pk. On Bouteloua racemosa.
 UROMYCES EUPHORBIE Pk. On various Euphorbias.
 UROMYCES EUPHORBIE Pk., var., MINOR Arth. On Euphorbia marginata.
 UROMYCES HEDYSARI-PANICULATA Arthur. On Desmodium.
 UROMYCES HOWEI Pk. On Milkweed (*Asclepias*).
 UROMYCES HYPERICI-FRONDOSI Arth. On St. John's Wort.
 UROMYCES JUNCII Tul. On rushes (*Juncus*).
 UROMYCES LESPEDEZE Pk. On Lespedeza.
 UROMYCES PHASEOLI Winter. On Wild bean.
 UROMYCES POLYGONI Winter. On Knotgrass.
 UROMYCES POLYMORPHUS Pk. & C. On Wild Vetch.
 UROMYCES TOXICODENDRI B. & R. On Poison Ivy.
 PUCCINIA AMORPHÆ Curt. On Amorpha.
 PUCCINIA ANDROPOGI Schw. On Blue stem (*Andropogon*).
 PUCCINIA ANEMONES-VIRGINIANÆ Schw. On Anemones.
 PUCCINIA ANGUSTATA Pk. On Sedges (*Cyperus*).
 PUCCINIA ASTERIS Duby. On Wild Aster.
 PUCCINIA ARUNDINARIÆ Schw. On Cord Grass.
 PUCCINIA CARICIS Wint. On Sedges (*Carex*).

* This list is based on Professor Arthur's list of Iowa Uredineæ.

- PUCCINIA CIRCÆÆ Pers. On *Circæa*.
- PUCCINIA CONVULVULI Wint. On Wild Morning Glory.
- PUCCINIA ELEOCHARIS Arthur. On Spike-Rush (*Eleocharis*).
- PUCCINIA FLOSCULOSORUM Wint. On Dandelion.
- PUCCINIA GALIORUM Link. On Bedstraw (*Galium*).
- PUCCINIA GENTIANÆ Wint. On Gentians.
- PUCCINIA GERARDII Pk. On Wild Aster.
- PUCCINIA GRAMINIS Pers. This is the common rust of Wheat, Oats and Barley.
- PUCCINIA LOBELIÆ Gerard. On Great Lobelia.
- PUCCINIA MAYDIS Carrad. Very common on leaves of Indian corn.
- PUCCINIA MENTHÆ Pers. On Mints.
- PUCCINIA OBTECTA Pk. On Great Bulrush.
- PUCCINIA PIMPINELLÆ Wint. On Sweet Cicely (*Osmorrhiza*).
- PUCCINIA PODOPHYLLI Schw. On May Apple.
- PUCCINIA POLYGONI-AMPHIBII Pers. On Polygonum.
- PUCCINIA PROSERPINACÆ Farl. On *Proserpinaca*.
- PUCCINIA PRUNORUM Lk. On leaves of young Wild Cherry.
- PUCCINIA RUBIGO-VERA Wint. This is the gray colored rust of wheat. It is much more harmful than the common rust (*P. graminis*), and every year causes a great loss in the wheat crop.
- PUCCINIA SILPHII Schw. On Cup-plant (*Silphium*).
- PUCCINIA SPOROBOLI Arthur. On a wild grass (*Sporobolus*).
- PUCCINIA STIPÆ Arthur. On Porcupine grass.
- PUCCINIA TANACETI DC. On Wild Sunflowers and Ironweed.
- PUCCINIA THALICTRI Chev. On Meadow Rue.
- PUCCINIA VERONICÆ Wint. On Culver's-root.
- PUCCINIA XANTHII Schw. On Cocklebur.
- PHRAGMIDIUM SPECIOSUM Fries. On Wild Rose.
- PHRAGMIDIUM SUBCORTICIUM Wint. On Wild Rose.
- GYMNOSPORANGIUM MACROPUS Lk. This is the large, so-called "Cedar Apple," so common in the spring of the year upon the Red Cedar trees.
- MELAMPSORA POPULINA Wint. On Cottonwood leaves.
- MELAMPSORA SALICINA Lev. On Willow leaves.
- COLEOSPORIUM SONCHI-ARVENSIS Wint. On Asters and Golden rods.

*Order Ustilagineæ. The Smuts. **

USTILAGO BISTORTARUM DC. On Polygonum.

* This list is based upon Professor Arthur's list of Iowa Ustilaginæ.

- USTILAGO DESTRUENS Duby. On Old Witch Grass.
- USTILAGO HYPODYTES Schlecht. On Wild Rye.
- USTILAGO JUNCII Schw. On rushes (*Juncus*).
- USTILAGO ZEÆ-MAYS Winter. On Indian corn affecting mostly the ears and tassels. (See the figures and description on preceding pages).
- USTILAGO MINIMA Arth. On Porcupine grass.
- USTILAGO NEGLECTA Niessl. On Yellow Foxtail.
- USTILAGO SEGETUM Winter. On heads of wheat, oats and barley, being the Black Smut described and figured on preceding pages.
- USTILAGO SPERMOPHORUS B. & C. On *Eragrostis poæiodes*, var *megastachya*.
- USTILAGO UTRICULOSA Nees. On Smartweeds.
- SOROSPORIUM BULLATUM Schr. On Barnyard grass.
- TILLETIA TRITICI Winter. On wheat, being the Stinking Smut, described and figured on a preceding page.
- THECAPHORA ATERRIMA Tul. On a sedge.
- ENTYLOMA BESSEYI Farl. On leaves of Black Nightshade and Ground Cherry.
- UROCYSTIS ANEMONES Pers. On Hepatica leaves.
- UROCYSTIS OCCULTA Wint. On Wild Rye.

CLASS IV. THE STALK SPORED FUNGI (*Basidiomycetes*).

Order Gasteromycetes.

- HYMENOGASTER VULGARIS Tul.? In the ground in woods.
- SIMBLUM RUBESCENS Gerard. This strange plant of an abominable odor has been collected twice in fields several miles north of Ames.
- PHALLUS IMPUDICUS L. The stink-horn fungus.
- PHALLUS DUPLICATUS Bosc. A specimen collected some years ago and preserved in alcohol is clearly referable to this species.
- CYATHUS VERNICOSUS DC. Bird's-nest Fungus.
- CRUCIBULUM VULGARE Tul. Bird's-nest Fungus.
- GEASTER SACCATUS Fr. Rare in woods but abundant under planted pines.
- BOVISTA NIGRESCENS Pers. In pastures.
- BOVISTA PLUMBEA Pers. In pastures, very abundant.
- LYCOPERDON GIGANTEUM Batsch. The Giant Puff-ball. Common in fields. Specimens have been collected over a foot in diameter.

LYCOPERDON CYATHIFORME Bosc. Common in fields, in the late autumn.

LYCOPERDON ATROPURPUREUM Vitt. Common in the autumn in shady places.

LYCOPERDON WRIGHTII B. & C. Very common in pastures and readily distinguished by its beautifully stellate-warted surface.

LYCOPERDON GEMMATUM Batsch. On stumps in woods.

LYCOPERDON MOLLE Pers. Under spruce trees.

LYCOPERDON PYRIFORME Schæff. The most common puff-ball of the woods, where it grows on the ground under trees, and on decaying stumps.

SECOTIUM WARNEI Peck. This curious plant is externally much like a Lycoperdon, and if examined internally when old and shedding its spores, its resemblance is still quite marked. However, if examined when young, its spores are found to be borne upon a mass of folded and crinkled plates which remind one very much of the spore-bearing plates of the Toadstools. This resemblance is all the more significant when we compare an *unopened* Toadstool with a perfect Secotium.

Order Hymenomycetes. The Toadstools, &c.

AGARICUS VAGINATUS Bull. Our plant is the variety *albida*.

AGARICUS MUSCARIUS L.? The Fly Agaric. Specimens collected some years ago were referred to this species.

AGARICUS PROCERUS Scop. In Maple grove.

AGARICUS NAUCINUS Fr. This toadstool is common in open ground in the autumn.

AGARICUS SARCOPHYLLUS Peck. In grass.

AGARICUS TERREUS Schæff. In grass under pines.

AGARICUS NIPHETUS Ellis. On rotten logs in the woods.

AGARICUS OSTREATUS Jacq. On dying Lombardy popular trees in late autumn.

AGARICUS VELUTIPES Curt. On decaying log.

AGARICUS UMBELLIFERUS Linn. In grass late in autumn.

AGARICUS LONGICAUDUS Pers. In grass in autumn.

AGARICUS CAMPESTRIS L. The Edible Mushroom. On old horse dung in a grove.

AGARICUS PERPLEXUS Peck. This beautiful and striking toadstool grows solitary or gregariously in grass late in the season.

COPRINUS ATRAMENTARIUS Fr. Very large specimens of this "Ink Toadstool" are common. They have been collected 6 to 8 inches in height, and from 3 to 4 inches in width.

CORTINARIUS CASTANEUS Fr. In grass.

CORTINARIUS COMMUNIS Peck. In grass among pines.

LENTINUS LECONTEI Fr. On dead branches of fallen trees.

LENTINUS TIGRINUS Fries. What is regarded by Berkeley as a monstrous form of this species is frequently found in this flora.

SCHIZOPHYLLUM COMMUNE Fr. Very common everywhere. Found once growing abundantly on the staves of a water barrel in the College Boarding Hall. The barrel had previously contained alcohol.

LENZITES BETULINA Fr. On oak wood.

LENZITES SEPIARIA Fr. On willow wood.

BOLETUS LUTEUS L. In grass.

BOLETUS FLAVUS With. In grass.

BOLETUS FLAVIDUS Fr. In grass. A most beautiful golden yellow species marked with vermillion splashes and blotches.

BOLETUS ORNATIPES Peck. A large and striking species.

STROBILOMYCES STROBILACEUS Berk.

POLYPORUS SULFUREUS Fr. On rotten logs.

POLYPORUS FUMOSUS Fr. On old stumps.

POLYPORUS ADUSTUS Fr. On rotten stumps.

POLYPORUS GILVUS Fr. On decaying logs.

POLYPORUS SCRUPOSUS Fr. On decaying logs. Possibly a variety of the preceeding.

POLYPORUS APPLANATUS Fr. On logs.

POLYPORUS FOMENTARIUS Fr. On logs.

POLYPORUS BERKELEYI Fr.? On rotten logs.

POLYPORUS HIRSUTUS Fr. On stumps.

POLYPORUS VERSICOLOR Fr. On stumps.

POLYPORUS CINNABARINUS Fr. On logs.

POLYPORUS RESINOSUS Fr. On logs.

POLYPORUS VULGARIS Fr. On decaying wood in woodpile.

POLYPORUS CORTICOLA Fr. On decaying pine boards.

POLYPORUS VAPORARIUS Fr. On bark of old stumps.

TRAMETES SUAVEOLENS Fr. On decaying wood.

TRAMETES SEPIUM Berk. On stumps.

DÆDALEA UNICOLOR Fr. On stumps.

FAVOLUS EUROPÆUS Fr.

MERULIUS TREMELLOSUS Schrad. On very rotten log.

- MERULIUS INCARNATUS* ——— On a rotten log, in winter.
HYDNUM CAPUT-MEDUSÆ Bull. In a hollow tree.
HYDNUM CORALLIOIDES Scop. In woods on a decayed ash tree.
IRPEX SINUOSUS Fr. On old trunks of plum and cherry.
IRPEX OBLIQUUS Fr. On dead branches of apple trees.
THELEPHORA PEDICELLATA Schw. On bark of decaying wood.
THELEPHORA LACINIATA Pers? On the ground under pine trees,
forming irregular brown branching growths covering a space
as large as one's hand.
STEREUM HIRSUTUM Fr. Common on stumps.
STEREUM VERSICOLOR Fr. Still more common than the last, on
stumps.
STEREUM COMPLICATUM Fr. On stumps.
STEREUM RADIATUM Pk. On stumps.
STEREUM SPADICEUM Fr.? On stumps.
STEREUM ACERINUM Fr. On decaying logs.
CORTICIUM LÆVE Fr. On decaying basswood.
CORTICIUM RUBRO-CANUM Thum. On oak bark.
SOLENTIA ANOMALA Fr. On split surface of basswood.
CLAVARIA STRICTA Pers.? In stumps.
TREMELLA sp. On decaying logs.
EXIDIA AURICULA-JUDÆ Fr.

PRELIMINARY LIST OF BRYOPHYTES OF THE AMES
FLORA.CLASS I. THE LIVERWORTS. (*Hepaticæ.*)*Order Ricciaceæ.*

RICCIA GLAUCA L. On the naked ground in a maple grove.

Order Anthocerotaceæ.

ANTHOCEROS LÆVIS L. On wet ground.

Order Marchantiaceæ.

MARCHANTIA POLYMORPHA L. Common about springs and on moist banks.

CONOCEPHALUS CONICUS Dumort. Common on moist banks.

Order Jungermaniaceæ.

FRULLANIA EBORACENSIS Gottsche. On the north sides of sugar maple trees.

MADO THECA PLATYPHYLLA Dumort. On stones in woods; not common.

CLASS II. THE MOSSES (*Musci.*)*Order Sphagnaceæ.*

This order which contains the peat Mosses appears to be entirely wanting in the State of Iowa. It may, however, be looked for in the Northeastern portion where possibly it may occur.

Order Bryaceæ.

ASTOMUM NITIDULUM Schimp. On the ground in grass.

WEISIA VIRIDULA Brid. On ground in woods.

DICRANELLA VARIA Schimp. Shaded banks.

FISSIDENS BRYOIDES Hedw.

LEUCOBRYUM VULGARE Hampe. On ground.

CERATODON PURPUREUS Brid. On ground in woods.

BARBULA SP. (immature.) On ground in woods.

ORTHOTRICHUM STRANGULATUM Beauv. On tree trunks.

PHYSCOMITRIUM PYRIFORME Brid.

PHYSCOMITRIUM HOOKERI Hampe. On ground in low fields.

FUNARIA HYGROMETRICA Sibth., var. calvescens.

BARTRAMIA POMIFORMIS Hedw.

BRYUM INTERMEDIUM Brid.

BRYUM ARGENTEUM Linn.

- MNIUM CUSPIDATUM* Hedw. On ground in woods.
TIMMIA MEGAPOLITANA Hedw. On ground in woods.
ATRICHUM ANGUSTATUM B. & Sch. On ground in woods.
POLYTRICHUM JUNIPERINUM Willd. In a ravine.
POLYTRICHUM COMMUNE Linn. On wet bluffs.
ANOMODON ROSTRATUS Sch. On ground in woods.
ANOMODON OBTUSIFOLIUS B. & Sch. About tree roots.
PLATYGYRIUM REPENS B. & Sch.
PYLAISSIA POLYANTHA B. & Sch. On logs.
PYLAISSIA INTRICATA B. & Sch. On trees.
PYLAISSIA VELUTINA B. & Sch. On logs.
CYLINDROTHECIUM CLADORRHIZANS Sch. On logs in woods.
CLIMACIUM DENDROIDES Web. & Mohr.
HYPNUM DELICATULUM Linn.
HYPNUM LÆTUM Brid.
HYPNUM ACUMINATUM Beauv., var. *rupincolum* On decaying logs
in woods.
HYPNUM SERPENS Linn.
HYPNUM RADICALE Beauv. On stones in woods.
HYPNUM IMPONENS Hedw.

PRELIMINARY LIST OF IOWA UREDINEÆ.

BY J. C. ARTHUR.

A sufficiently large number of species of *Uredineæ* have been collected in the state to make it desirable that a list be published, in order that collectors may know what has been and what has not been found. The list already seems long, but it is, however, very far from being complete. It is based upon the collection in the herbarium of the Iowa Agricultural College, supplemented by the collection of the writer. Every locality cited is represented by a specimen, which may be the subject of further study at any time.

The determination of many of the species has been rendered troublesome by the lack of good material showing the uredo stage, and by neglect to procure evidences at the time of collection by which the host can be accurately determined. Especially is this the case among grasses and sedges, and collectors cannot be too careful about these points. Some fragments of flowers, seeds, or inflorescence may usually be found, if not perfect ones, and should always accompany the specimens. Teleutospores on grasses and sedges may often be found during the winter, and are particularly valuable to show the perfectly mature state of the species. In cases where no uredo is ever produced it is as important to establish the fact as in other cases to collect the uredo.

The alphabetical classification adopted for the present paper is necessitated by a lack of knowledge of the relationships of the American species. In the first place observations and material are not sufficiently complete, as has been partially indicated above, and then there is need of some experimental knowledge, which can only be obtained by means of cultures. There is no reason why any acute observer who possesses a microscope may not be entirely successful in this line of research, which requires no special apparatus or facilities of any kind. It is an attractive field that ought to be cultivated.

All the æcidia have been placed by themselves, with the exception of those belonging to *Phragmidium*, for the sake of uniformity, for although a few may be distributed to their respective teleutospore forms with entire confidence, the majority must await the decision of experimental tests. The æcidia of *Phragmidium* are often mistaken for uredo, but can be easily distinguished under the

microscope by the æcidiaspores being in chains of three or more, while the uredospores are borne singly on pedicels.

I am very deeply indebted to Professor C. E. Bessey, who has given me the use of the collections belonging to the college herbarium, and also of his own, and to Mr. E. W. Holway who has furnished material for a very large part of the work, including many interesting forms often overlooked by collectors, and has otherwise given much assistance.

All the specimens from Decorah were collected by Mr. Holway, the larger part of those from Ames by Professor Bessey, and part of those from Ames and all from Charles City and Spirit Lake by the writer. The localities are mentioned in the order in which specimens were communicated.

1. UROMYCES ACUMINATUS Arth. Bull. Minn. Acad. Nat. Sci., II.

- II. On *Spartina cynosuroides* Willd. Spirit Lake, Decorah, Ames.

- III. On *S. cynosuroides* Willd. Ft. Dodge, Decorah, Spirit Lake, Ames.

2. UROM. APICULATUS Lev. Ann. Sci. Nat. Ser., 3, VIII, p. 375.

- II. On *Trifolium repens* L. Decorah.

- III. On *T. repens* L. Decorah.

3. UROM. BRANDEGI Pk. Bot. Gaz., IV, p. 127.

- III. On *Bouteloua racemosa* Lag. Decorah, Ames, Spirit Lake.

It is the opinion of Dr. Farlow (Proc. Am. Acad., XVIII, p. 82) that this is only a of state *Puccinia vexans*, possibly the uredo form, but until the matter is demonstrated it is best to retain the name. Specimens of rust on *Bouteloua*, collected at Spirit Lake in March of this year were entirely free from the one-celled form, and therefore give a little additional evidence in favor of Dr. Farlow's views.

5. UROM. CALADII (Schw.) Uredo caladii Schw., Syn. Fung. Car. Sup. No. 480.

- III. On *Arisæma triphyllum* Torr. Decorah.

5. UROM. ERYTHRONII (DC.) Wint. Kryp. Fl. v. Deutschl., I, p. 149. (*U. liliacearum* Unger.)

- II. On *Lilium superbum* L. Decorah.

- III. On *L. superbum* L. Decorah.

6. UROM. EUPHORBIE (Schw.) Uredo euphorbiæ Schw. Syn. Fung. Car. Sup., No. 459

- II. { On *Euphorbia glyptosperma* Engelm. Charles City.
On *E. heterophylla* L. Charles City.
On *E. hypericifolia* L. Ames.
On *E. maculata* L. Ames.
- III. { On *E. glyptosperma* Engelm. Charles City, Spirit Lake.
On *E. maculata* L. Decorah, Ames.
On *E. hypericifolia* L. Ames.
On *E. heterophylla* L. Charles City, Decorah.
7. UROM. EUPHORBIE (Schw.) var. MINOR Arth. Bull. Minn. Acad. Nat. Sci., II.
III. On *Euphorbia marginata* Pursh. Ames.
8. UROM. HEDYSARI-PANICULATI (Schw.) Puccinia hedysari-paniculati Schw., Syn. Fung. Car. Sup., No. 503. (Urom. solida B. & C.)
III. On *Desmodium sessilifolium* T. & G. Ames.
9. UROM. HOWEI Peck. 30th Rep. N. Y. St. Mus., p. 75.
III. { On *Asclepias cornuti* Dec. Ames, Decorah.
On *A. tuberosa* L. Decorah.
On *A. incarnata* L. Decorah.
10. UROM. HYPERICI-FRONDOSI (Schw) Arth. Bull. Minn. Acad. Nat. Sci., II. (II.—*Trichobasis hyperici* Gerard.)
III. On *Hypericum pyramidatum* Ait. Ames, Decorah.
11. UROM. JUNCII Tul. Ann. Sci. Nat., Ser., 4. II.
II. On *Juncus tenuis* Willd. Ames.
III. On *J. tenuis* Willd. Ames.
12. UROM. LESPEZIE (Schw.) Pk. 29th Rep. N. Y. St. Mus., p. 68. (II. — *Uredo lespedeziæ* Thm.)
II. On *Lespedeza capitata* Michx. Ames, Charles City.
III. { On *L. capitata* Michx. Charles City, Ames, Decorah.
On *L. leptostachya* Engelm. Lyon Co., Ft. Dodge, Ames, Emmet Co., Decorah.
13. UROM. PHASEOLI (Pers.) Wint. Kryp, Fl. v. Deutschl., I, p. 157.
III. On *Phaseolus diversifolius* Pers. Ames.
14. UROM. POLYGONI (Pers.) Wint. Kryp. Fl. v. Deutschl., I, p. 154.
III. { On *Polygonum aviculare* L. Ames.
On *P. erectum* L. Charles City.

15. *UROMORBI* (Pers.) Wint. Krypt. Fl. v. Deutschl., I, p. 158.
(*U polymorphus* P & C.)
II. On *Vicia americana* Muhl. Ames.
III. { On *V. americana* Muhl. Ames.
On *Lathyrus venosus* Muhl. Decorah, Mason
City, Spirit Lake.
16. *UROM. PYRIFORMIS* Cke. 29th Rep. St. N. Y. Mus., p. 69.
III. On *Acorus calamus* L. Decorah.
17. *UROM. RUDBECKIÆ* Arthur and Holway (*n. sp.*)
III. Sori on the under surface of the leaf, compact, confluent into raised, mostly rounded, masses with a depressed center, naked, light brown; encircling epidermis obscure: telentospores elliptical to pear-shape, smooth, pale golden brown, 9 to 15^{mm} broad * by 20 to 30^{mm} long; wall thin; apex about 6^{mm} thick, narrowed into a broad obtuse point, or more rarely rounded, or broadly conical; base from narrow wedge-shape to broad and obtuse; pedicel rather broad but delicate, colorless, once to twice as long as the spores. Differs from *U. Solidaginis* Niessl. principally in the slenderer spores with less thickened and lighter colored apex.
On *Rudbeckia laciniata* L. Decorah.
18. *UROM SPARGANII* C. & P. 26th Rep. N. Y. St. Mus., p. 76.
II. On *Sparganium eurycarpum* Engelm. Decorah.
III. On *S. eurycarpum* Engelm. Hancock Co., Decorah.
19. *UROM TOXICODENDRI* B. & R. Grev. III, p. 56. (II. *Pileolaria brevipes* B. & R.)
II. On *Rhus toxicodendron* L. Decorah, Ames, Spirit Lake.
III. On *R. toxicodendron* L. Decorah.
20. *PUCCINIA AMORPHÆ* Curtis. Grev., III, p. 55.
II. On *Amorpha fruticosa* L. Ames, Decorah, Spirit Lake.
III. { On *A. fruticosa* L. Decorah, Charles City, Ames,
On *A. canescens* Nutt. Ames, Decorah.
On *A. microphylla* Pursh. Spirit Lake.

* On account of the want of proper type, the abbreviation *mm* is used for Micromillimetre in place of the usual Greek letter. A Micromillimetre is .00001 of a Metre, and equals .000394 of an inch, or about one twenty-five thousandths of an inch. C. E. B.

21. PUC. ANDROPOGI Schw. Syn. Fung. Am. Bor., No. 29 II.
(*P. ellisiana* Thm.)
- III. { On *Andropogon furcatus* Muhl. Decorah, Charles
City, Spirit Lake.
On *A. scoparius* Michx. Ames, Decorah, Spirit Lake.
22. PUC. ANEMONES-VIRGINIANÆ Schw. Syn. Fung. Car. Sup., p.
46. (*P. solida* Schw.)
- III. { On *Anemone cylindrica* Gr. Ames.
On *A. virginiana* L. Decorah, Charles City.
23. PUC. ANGUSTATA Peck. 25th Rep. N. Y. St. Mus., p. 123.
- II. On *Cyperus strigosus*. Ames.
- III. { On *C. strigosus* L. Ames.
On *Scirpus atrovirens* Muhl. Charles City, Ames,
Decorah, Spirit Lake.
On *Eriophorum polystachyon* L. Decorah.
24. PUC. ASTERIS Duby. Botan. Gallic., II, p. 888. (*P. asteris*.
Schw)
- III. { On *Aster novæ-angliæ* L. Decorah.
On *A. azureus* Lindl. Ames.
25. PUC. ARUNDINARIÆ Schw. Syn. Fung. Car. Sup. No. 487.
- III, On *Spartina cynosuroides* Willd. Ames, Charles City,
Ft. Dodge, Decorah, Spirit Lake.
- The sori closely resemble those of *P. phragmitis*, but the spores
are very different, being in some respects more like those of *P.*
graminis. A very abundant species.
26. PUC. CALTIÆ Link. In Linnæus' Spec. Plant. VI, 2, p. 79.
- On *Caltha palustris* L. Spirit Lake.
- III. On *C. palustris* L. Decorah, Spirit Lake.
27. PUC. CARICIS (Schum.) Wint. Kryp. Fl. v. Deutschl., I, p. 222,
(*P. striola* Lk.)
- III. { On *Carex strieta* Lam. Spirit Lake, Ames, Decorah.
On *C. adusta* Boott. Spirit Lake.
On *C. straminea* Schk. Spirit Lake.
28. PUC. CIRCÆÆ Pers. Dispos. method., p. 39.
- III. On *Circæa lutetiana* L. Decorah, Ames.
29. PUC. CONVULVULI (Pers.) Winter. Krypt. Fl. v. Deutschl., I,
p. 204. (*P. convolvuli* B. & C.)
- III. On *Convolvulus sepium* L. Decorah, Ames.
30. PUC. CORONATA Cda. Icones I, p. 6.

- III. { On *Avena sativa* L. Ames, Spirit Lake, Decorah.
 { On *Phalaris arundinacea* L. Decorah.
 { On *Cinna arundinacea* L. Ames.

31. PUC. CRYPTOTÆNIÆ Peck. 23d Rep. N. Y. St. Mus., p. 56.

III. On *Cryptotænia canadensis* DC. Decorah.

32. PUC. CYPRIPIEDII Arthur and Holway (*n. sp.*)

II. Sori round, flattened, scattered on the under surface of the leaf, brown, naked; encircling epidermis noticeable; uredospores round to elliptical, sparsely echinulate with low blunt points, rather dark brown, 14 to 18^{mm} broad by 17 to 22^{mm} long.

III. Sori scattered over the under surface of the leaf; rounded, cushion-shape, black, polished; encircling epidermis rather inconspicuous; teleutospores oblong or oblong-obovate, smooth, constricted in the middle, brown, 16 to 18^{mm} broad by 30 to 42^{mm} long; wall rather thin; apex strongly thickened, flattened, rounded, or obtuse, 6 to 10^{mm} thick; base obtuse or more rarely acute; pedicel as long or shorter than the spore, delicate, colorless.

On *Cypripedium pubescens* Willd. Decorah.

33. PUC. DAYI Clinton. 28th Rep. N. Y. St. Mus., p. 61.

III. On *Steironema ciliatum* Rap. Decorah.

34. PUC. ELEOCHARIS Arthur (*n. sp.*)

II. Uredospores polygonal-globose to egg-shape, yellow, minutely and sparingly warty, 18 to 24^{mm} broad by 18 to 30^{mm} long.

III. Sori round or nearly so, scattered, raised, nearly black, long covered by the epidermis which splits lengthwise; teleutospores oblong-wedge-shape, slightly or not at all constricted at the middle, brown or blackish brown, 16 to 20^{mm} broad by 45 to 54^{mm} long; wall thin; apex considerably or not at all thickened, squarely or obliquely truncate, rounded, or rarely broad-cone-shape; base wedge-shape, or slightly inflated; pedicel thick, extremely short.

On *Eleocharis intermedia* Schul. Spirit Lake.

On *E. palustris* R. Br. Ames.

No uredosori were seen, and only a few urespores. The teleutospores on *E. palustris* have the apex thicker and more rounded, than on *E. intermedia*.

- PUC. EMACULATA Schw. Syn. Fung. Am. Bor., No. 2912. (P. graminis Pers., var. brevicarpa Peck.)
 III. On Panicum capillare L. Ames, Decorah.
36. PUC. FLOSCULOSORUM (A. & S.) Wint. Kryp. Fl. v. Deutschl. I, p. 206. (P. compositarum Schlecht., P. variabilis Grev.)
 II. { On Taraxacum officinale Weber. Charles City, Ames.
 { On Troximom cuspidatum Pursh. Decorah.
 { On Tar. officinale Weber. Charles City; Decorah, Ames.
 III. { On Trox. cuspidatum Pursh. Decorah.
 { On Cnicus altissimus Willd., var. discolor Gr. Decorah.
37. PUC. FUSCA (Rhelh.) Wint. Kryp. Fl. v. Deutschl., I, p. 199. (P. anemones Pers.)
 III. { On Anemone nemorsa L. Decorah.
 { On A. patens L. var. nuttalliana Gr. Decorah.
38. PUC. GALIORIUM Link. Spec. Plant., II, p. 76.
 III. { On Galium aparine L. Decorah.
 { On G. boreale L. Decorah.
 { On G. concinnum T. & G. Decorah, Ames.
39. PUC. GENTIANÆ (Strauss.) Wint. Kryp. Fl. v. Deutschl., I, p. 205.
 II. On Gentiana quinqueflora Lam., var. occidentalis Gr. Decorah.
 III. On G. puberula Michx. Ames, Plymouth Co., Decorah.
40. PUC. GERARDII Peck. 25th Rep. N. Y. St. Mus., p. 91.
 III. On Aster paniculatus Lam. Ames.
41. PUC. GRAMINIS Pers. Dispos. method., p. 39.
 II. { On Avena sativa L. Ames.
 { On Triticum vulgare Vill. Ames, Charles City.
 { On Av. sativa L. Ames, Spirit Lake.
 { On T. vulgare Vill. Ames.
 { On Agrostis vulgaris With. Decorah.
 III. { On Ag. scabra Willd. Spirit Lake.
 { On Elymus canadensis L. Spirit Lake.
 { On Muhlenbergia mexicana Trin. Ames, Decorah.

The form on *Muhlenbergia* differs somewhat from the others, but does not seem to merit specific description.

42. PUC. HYDROPHYLLI P. & C. 30th Rep. N. Y. St. Mus., p. 54.
III. On *Hydrophyllum virginicum* L. Decorah.
43. PUC. VERRUCOSA (Schultz.) Wint. Krypt. Fl. v. Deutschl., I, p. 166. (*P. hyssopi* Schw.)
III. On *Lophanthus nepetoides* Benth. Decorah.
44. PUC. LOBELIÆ Gerard. Bull. Buffalo Soc. Nat. Sci., I, p. 66. (*P. microsperma* B. & C.)
III. On *Lobelia syphilitica* L. Ames.
45. PUC. MENTHÆ Pers. Synops. Fung., p. 227.
II. { On *Monarda fistulosa* L. Charles City, Ames.
On *Pycnanthemum lanceolatum* Pursh. Spirit Lake.
III. { On *M. fistulosa* L. Charles City, Decorah, Ames.
On *P. lanceolatum* Pursh. Charles City, Decorah, Ames.
On *Mentha canadensis* L. Ames, Decorah,
46. PUC. NOLITANGERIS Cda. Icones IV, p. 439. (*P. argentata* Wint.)
II. On *Impatiens pallida* Nutt. Decorah.
III. On *I. pallida* Nutt. Decorah, Charles City.
47. PUC. OBSCURA Schroet. Nuovo Giorn. Botan. Ital., IX, p. 256.
II. On *Luzula campestris* DC. Emmet County.
48. PUC. OBTECTA Peck. 25th Rep. N. Y. St. Mus., p. 121.
II. On *Scirpus validus* Vahl. Decorah.
III. On *S. validus* Vahl. Charles City, Decorah, Ames.
49. PUC. PHRAGMITIS (Schum.) Wint. Kryp. Fl. v. Deutschl., I, p. 179. (*P. arundinacea* DC.)
III. On *Phragmites communis* Trin. Spirit Lake, Mason City.
50. PUC. PIMPINELLÆ (Strauss) Wint. Kryp. Fl. v. Deutschl., I, p. 212. (*P. osmorrhizæ* C. & P.)
II. On *Osmorrhiza longistylis* DC. Decorah.
II. { On *Osmorrhiza longistylis* DC. Decorah.
On *O. brevistylis* DC. Decorah.
51. PUC. PODOPHYLLI Schw. Syn. Fung. Car. Sup., No 489, (*P. aculaeta* Link.)
III. On *Podophyllum peltatum* L. Ames, Decorah.

52. PUC. POLYGONI-AMPHIBII Pers. Synop. Fung., p. 227.
 II. On *Polygonum hartwrightii* Gr. Ames.
 III. { On *P. hartwrightii* Gr. Charles City, Ames, Spirit Lake.
 { On *P. muhlenbergii* Wats. Charles City, Ames, Spirit Lake.
53. PUC. PROSERPINACE Farlow. Proc. Am. Acad., XVIII, p. 80.
 II. On *Proserpinaca palustris* L. Boone.
54. PUC. PRUNORUM Link. Spec. Plant., II, p. 82.
 III. { On *Prunus serotina* Ehr. Decorah, Ames.
 { On *P. americana* Mars. Decorah.
55. PUC. BUBIGO-VERA (DC.) Wint. Kryp. Fl. v. Deutschl., I, p. 212. (*P. straminis* Fekl.)
 II. On *Triticum vulgare* Vill. Ames.
 III. { On *T. vulgare* Vill. Ames, Decorah.
 { On *Elymus canadensis* L. Spirit Lake.
56. PUC. SILPHII Schw. Syn. Fung. Am. Bor., No. 2929.
 III. On *Silphium perfoliatum* L. Decorah, Ames.
57. PUC. MAYDIS Carrad. Giorn. di Fisica d. Brugn. VIII. (*P. sorghi* Schw.)
 III. On *Zea mays* L. Decorah, Charles City, Ames.
58. PUC. SPOROBOLI Arthur (*n. sp.*)
 II. Uredospores yellow, round, minutely roughened, 24 to 28^{mm} in diameter.
 III. Sori on the leaves and stem, oblong or linear, brownish black, early naked; encircling epidermis, not very conspicuous; teleutospores oblong to oblong-clavate, smooth, somewhat or not at all constricted in the middle, deep brown at least above, 15 to 21^{mm} broad by 28 to 45^{mm} long; apex thickened, semicircular to obtuse; base acutish, or less often obtuse; pedicel rather stout, as long or shorter than the spore, colored.
 On *Sporobolus heterolepis* Gr. Ames, Spirit Lake, Decorah.
 It is accompanied by, or it may be better to say that the host bears, one-celled teleutospores, which are sometimes produced in abundance without intermixture of the two-celled form. The description of the sori, and of the color, apex, base and pedicel of the two-celled form applies equally well to the one-celled, except that the pedicel still remains as long as the two-celled spore,

i. e. one to two and a half times the length of the one-celled spore. The one-celled spore is elliptical to oblong-clavate or, oblong-fusiform, or even obvate, 14 to 18^{mm} broad, by 18 to 24^{mm} long. The probability of its being an early state of the telentosporic form of the *Puccinia* of the same host, as we find in *P. vexans* and *P. lantanae*, makes it undesirable to describe it as a *Uromyces*, and yet its relation to the two-celled form requires further confirmation.

59. PUC. SPRETA Peck. 29th Rep. N. Y. St. Mus., p. 67.

III. On *Mitella diphylla* L. Decorah.

60. PUC. STIPÆ Arthur (*n. sp.*)

II. Sori oblong, small, mostly on the upper surface of the leaf, yellowish, inconspicuous, tardily naked; uredospores yellow, round to oblong or ovate, minutely roughened and with or without very fine points, 15 to 20^{mm} broad by 20 to 30^{mm} long.

III. Sori oblong, scattered over the upper surface of the leaf, very dark brown, soon naked; encircling epidermis inconspicuous; telentosporic oblong or less commonly oblong-obovate, smooth, brown, considerably constricted at the middle, 18 to 25^{mm} broad by 42 to 56^{mm} long; apex thickened, or sometimes thin, rounded to obtuse, sometimes acutish; base obtuse or somewhat narrowed; pedicel slightly colored, two to three times as long as the spore.

On *Stipa spartea* Trin. Ames.

61. PUC. TANACETI DC. Flore Franc., II, p. 222. (*P. helianthi* Schw.)

II. { On *Helianthus strumosus* L. Charles City.
 { On *Vernonia fasciculata* Michx. Ames.
 { On *H. strumosus* L. Charles City, Decorah.
 { On *H. tuberosus* L. Ames, Charles City.
 { On *H. grosse-serratus* Mart. Ames.
 { On *H. maximiliani* Schrad. Spirit Lake.
 { On *H. occidentalis* Rid. Decorah.

III. { On *H. rigidus* Desf. Ames, Spirit Lake.
 { On *V. fasciculata* Michx. Decorah, Ames.
 { On *V. noveboracensis* Willd. Creston.
 { On *Artemisia ludoviciana* Nutt. Decorah, Charles City.
 { On *A. dracunculoides* Pursh. Charles City.

62. PUC. THALICTRI Chev. Flor. Paris., I, p. 417.
III. On *Thalictrum diocum* L. Ames.
63. PUC. VERONICÆ (Schum.) Wint. Kryp. Fl. v. Deutschl., I, p. 166. (*P. veronicarum* DC.)
III. On *Veronica virginica* L. Ames.
64. PUC. VEXANS Farlow. Proc. Am. Acad., XVIII, p. 82.
III. { On *Bouteloua racemosa* Lag. Decorah, Spirit Lake.
On *Sporobolus cuspidatus* Torr. Spirit Lake.
65. PUC. VIOLÆ DC. Flore Franc., VI. p. 62.
II. On *Viola cucullata* Ait. Decorah.
III. { On *V. cucullata* Ait. Decorah.
On *V. pubescens* Ait. Decorah.
66. PUC. XANTHII Schw. Syn. Fung. Car. Sup., No. 500.
III. On *Xanthium canadense* Mill. Decorah, Ames, Spirit Lake.
67. PUC. ZYGADENI Trelease. Trans. Wis. Acad. Sci. VI.
III. On *Zygadenus elegans* Pursh. Decorah.
68. PHRAGMIDIUM GRACILE (Farlow). *P. incrassatum* Lk. var. *gracile* Far., in Ellis' N. Am. Fungi, III, No. 282.
I. *Æcidia*, round, small, sparingly scattered over the upper surface of the leaf, soon naked, yellow; spores in short chains from round to oblong, elliptical or ovate-spatulate, with thick wall and uneven surface, moderately echinulate with conical points, 12 to 20^{mm} broad by 16 to 24^{mm} long; paraphyses slender club-shape, strongly curved, colorless.
II. Not seen.
III. Sori rather small, round, on the under surface of the leaf, scattered, or loosely aggregated and confluent, black; teleutospores cylindrical, warty, dark opaque brown, of 4 to 9 cells, mostly 7 to 9, 30^{mm} broad by 75 to 100^{mm} long; apex abruptly narrowed into a prominent, colorless, obtuse point; pedicel colorless, thick, swollen in the lower half, one and a half times the length of the spore, the outer portion bursting when placed in water.

On *Rubus strigosus* Michx. Decorah.

This species as closely resembles the European *P. rubi-idæi* (Pers.), the *P. gracile* of Cooke's Handbook, as the

American host resembles the European one. It differs chiefly in the slightly smaller spores, different disposition of the æcidia, and the characteristic apex of the teleutospores.

69. *PHRAG. OBTUSUM* (Strauss) Wint. Kryp. Fl. v. Deutschl., I, p. 229.
 - II. On *Potentilla canadensis* L. Decorah.
 - III. On *P. canadensis* L. Charles City.
70. *PHRAG. SPECIOSUM* (Fr.) Aregina *speciosum* Fr., in Syst. Mycol., III, p. 406. (I. *Uredo miniata* Pers.)
 - I. *Æcidia* orange yellow, of various forms, usually confluent forming elongated swollen spots, often 12^{mm} long, on the stems and leaf-veins of the present year's growth, considerably bending and distorting them, or on the mesophyll of the leaf becoming small and roundish, early naked; encircling epidermis nearly white, conspicuous; spores in short chains, roundish to oblong, angular, minutely granular, somewhat enichulate, with thin walls, yellow, 16 to 24^{mm} broad by 20 to 30^{mm} long; paraphyses few, club-shape, nearly straight, colorless.
 - II. Not seen.
 - III. Sori longer than broad, mostly confluent, on swollen stems of previous year's growth, at first compact, finally felt-like black; teleutospores cylindrical, very dark brown, smooth, of 5 to 8 cells, mostly 7, 24 to 28^{mm} broad by 66 to 102^{mm} long; apex rounded or acutish, or more generally narrowed into a conical-obtuse, nearly colorless point; pedicel two to four times the length of the spore, colorless, tapering downwards.
On *Rosa blanda* Ait. Ames, Decorah, Charles City.
71. *PHRAG. SUBCORTICIUM* (Schrank) Wint. Kryp. Fl. v. Deutschl., I, p. 228. (*P. mucronatum* Lk.)
 - II. On *Rosa blanda* Ait. Spirit Lake.
 - III. On *R. blanda* Ait. Decorah, Ames, Spirit Lake.
72. *GYMNOSPORANGIUM CLAVARIEFORMIS* DC. Flore Franc., II, p. 217.
 - III. On *Juniperus communis* L. Decorah.
73. *GYM. CLAVIPES* C. & P. 25th Rep. N. Y. St. Mus., p. 89.
 - III. On *Juniperus virginiana* L. Decorah.

74. *GYM. MACROPUS* Lk. Spec. Plant., VI, p. 128.
 III. On *Juniperus virginiana* L. Decorah, Charles City,
 Ames.
75. *MELAMPSORA POPULINA* (Jacq.) Wint. Kryp. Fl. v. Deutschl.,
 I, p. 238.
 II. { On *Populus balsamifera* L. Charles City.
 { On *P. monilifera* Ait. Charles City, Ames.
 III. { On *P. balsamifera* L. Charles City.
 { On *P. monilifera* Ait. Charles City.
76. *MEL. SALICINA* Lev. Ann. Sci. Nat., VIII, p. 375.
 II. { On *Salix amygdaloides* Anders. Ames.
 { On *S. longifolia* Muhl. Charles City.
77. *COLEOSPORIUM SONCHI-ARVENSIS* (Pers.) Wint. Kryp. Fl. v,
 Deutschl. I, p. 237. (*C. solidaginis* Thm.)
 II. { On *Aster cordifolius* L. Ames.
 { On *A. drummondii* Lindl. Charles City, Ames.
 { On *Callistephus chinensis* Ness. Ames.
 { On *Silphium laciniatum* L. Ames.
 { On *Solidago canadensis* L. Charles City, Ames,
 Spirit Lake.
 { On *S. serotina* Ait. Spirit Lake.
 III. { On *S. canadensis* L. Ames.
 { On *S. Nemoralis* L. Ames.
78. *COL. VIBURNI* Arthur (*n. sp.*)
 II. Sori irregular shape, at first blister-form, becoming
 flattened, scattered over the under surface of the leaf,
 or gathered into indefinite groups, sometimes col-
 lescing into circles, orange yellow; uredospores near-
 ly round, or irregularly oblong, finely and thickly
 warty, pale yellow, 18 to 25^{mm} broad by 22 to
 30^{mm} long.
 On *Viburnum lentago* L. Charles City.
 The specimens were gathered in September, and no teleutos-
 pores had yet begun to form. The uredospores germi-
 nate with the greatest readiness, even while still in
 the sorus.
79. *CHRYSONYXA PIROLATUM* (Koern) Wint. Krp., Fl. v. Deutschl
 II. On *Pyrola elliptica* Nutt. Decorah.

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80. *URED O AGRIMONIAE* (DC.)

On *Agrimonia eupatoria* L. Charles City, Ames.

81. *UR. BOUTELOUÆ* Arthur (*n. sp.*)

Sori on the upper surface of the leaf, seated on yellow spots, small, yellow, elliptical or oblong, irregularly scattered, tardily naked; encircling epidermis inconspicuous, spores round, oblong or elliptical, rarely ovate, very minutely and sparingly echinulate, or quite smooth, orange yellow, 15 to 25^{mm} broad by 20 to 30^{mm} long; wall very thin; paraphyses numerous, intermixed with the spores, slender club-shape with slight constriction near the upper end, varying to capitate with a thick stalk, colorless, with thick walls and rounded apex, 13^{mm} broad at the upper end by 38 to 75^{mm} long.

On *Bouteloua racemosa* Lag.

The above description was given in Bull. Minn. Acad. Nat. Sci., II, where the plant was assumed to be the uredo stage of *Uromyces brandegei* Pk., a puzzling species, and as no teleutospores have been found in connection with the uredo, it is probably best to treat it separately until further developments.

82. *UR. IRIDIS* Duby.

On *Iris versicolor* L. Decorah.

83. *UR. POLYPODII* (Pers.) (*Uredo filicum* DC.)

On *Pellaea gracilis* Hook. Decorah.

84. *CÆOMA LUMINATUM* Schw.

On *Rubus villosus* Ait. Decorah, Charles City.

85. *ÆCIDIUM ACTÆÆ* Wallr.

On *Actæa alba* L. Decorah, Charles City.

86. *ÆC. ALBESCENS* Grev.

On *Adoxa moschatellina* L. Decorah, Charles City.

87. *ÆC. ASTERATUM* Schw.

On *Aster cordifolius* L. Ames.

88. *ÆC. BERBERIDIS* Gmel.

On *Berberis vulgaris* L. Charles City, Chickasaw Co., Decorah, Ames.

89. *ÆC. CALADII* Schw.
 On *Arisæma dracontium* Schott. Manchester, Ames.
 On *A. triphyllum* Torr. Charles City, Manchester.
90. *ÆC. PENTSTEMONIS* Schw.
Æcidia small, loosely gathered in mostly small irregular groups on both surfaces of the leaves; margin delicate, white, erect, nearly entire; spores polygonal-globose, smooth, yellow, 16 to 22^{mm} in diameter.
 On *Castilleia sessiliflora* Pursh. Ames.
 On *C. coccinea* Spreng. Decorah.
91. *ÆC. CLEMATIDIS* DC.
 On *Clematis virginiana* L. Decorah.
92. *ÆC. COMPOSITARUM* Mart.
 On *Helianthus strumosus* L. Decorah, Ames.
 On *Rudbeckia laciniata* L. Decorah.
 On *Senecio aureus* L. Decorah.
 On *Silphium laciniatum* L. Ames.
 On *Sil. perfoliatum* L. Ames, Decorah.
 On *Solidago latifolia* L. Ames.
 On *Sol. rigida* L. Decorah.
 Following the suggestion of Dr. Winter (Kryp. Fl. v. Deutschl., I, p. 264), all of our *æcidia* on *Compositæ* which are not suitably provided for are placed here. *Æcidia* have been gathered on several species of *Lactuca* and *Nabalus*, but as the hosts have not been carefully determined, the localities are omitted, hoping that better material may be collected hereafter.
93. *ÆC. CONVALLARIÆ* Schw.
 On *Polygonatum giganteum* Diet. Decorah. Ames.
 On *Uvularia grandiflora* Smith. Ames.
94. *ÆC. CRASSUM* Pers.
 On *Rhamnus alnifolia* L'Her. Decorah.
 On *R. lanceolata* Pursh. Boone Co.
95. *ÆC. CYPARISSIÆ* DC.
 On *Euphorbia commutata* Engelm. Decorah.
96. *ÆC. EPILOBI* DC.
 On *Oenothera biennis* L. Decorah, Ames, Spirit Lake.
97. *ÆC. ERIGERONATUM* Schw.
 On *Erigeron strigosus* Muhl. Decorah.
 On *E. philadelphicus* L. Ames.

98. *ÆC. EUPHORBIÆ* (Schw.)
 On *Euphorbia heterophylla* L. Decorah.
 On *E. maculata* L. Ames, Charles City.
99. *ÆC. FRAXINI* Schw.
 On *Fraxinus viridis* Michx. f. Ames, Spirit Lake.
100. *ÆC. GALII* Pers.
 On *Galium concinnum* T. & G. Decorah.
101. *ÆC. GERANII* DC.
 On *Geranium maculatum* L. Decorah, Ames.
102. *ÆC. GROSSULARIÆ* DC.
 On *Ribes cynosbati* L. Manchester.
 On *R. floridum* L. Charles City, Ames.
 On *R. gracile* Michx. Decorah, Charles City, Ames.
103. *ÆC. HEPATICATUM* Schw.
 On *Anemone acutiloba* Law. Decorah.
104. *ÆC. HYDNOIDEUM* B. & C.
 On *Dirca palustris* L. Decorah.
105. *ÆC. HYDROPHYLLI* Pk.
 On *Ellisia nyctelea* L. Decorah.
 On *Hydrophyllum virginicum* L. Ames.
106. *ÆC. HYPERICATUM* Schw.
 On *Hypericum pyramidatum* Ait. Decorah.
107. *ÆC. IMPATIENTATUM* Schw.
 On *Impatiens fulva* Nutt. Decorah.
 On *I. pallida* Nutt. Decorah, Ames, Spirit Lake.
108. *ÆC. IRIDIS* Ger.
 On *Iris versicolor* L. Decorah.
109. *ÆC. JAMESIANUM* Pk.
 On *Asclepias cornuti* Dec. Decorah.
 On *A. tuberosa* L. Decorah.
110. *ÆC. LEGUMINOSATUM* Lk.
 On *Amphicarpæa monoica* Nutt. Decorah.
 On *Apios tuberosa* Mœnch. Ames.
111. *ÆC. MENTHÆ* DC.
 On *Monarda fistulosa* L. Decorah.
112. *ÆC. NAPÆÆ* Arthur and Holway (*n. sp.*)

Æcidia in orbicular groups on under surface of the leaf, on small yellow spots; margin prominent, white, recurved, with large and small lobes; spores nearly round, varying to oblong and oval, nearly colorless, smooth,

or under high power minutely corrugated in places
15 to 18^{mm} broad by 16 to 22^{mm} long.

On *Napæa dioica* L. Decorah.

113. *ÆC. CENOTHERÆ* Pk.

On *Cenothera biennis* L. Decorah.

On *C. serrulata* Nutt. Ames.

114. *ÆC. OROBI* DC.

On *Trifolium repens* L. Decorah.

115. *ÆC. OXALIDIS* Thm.

On *Oxalis violacea* L. Ames.

The spores are a little smaller than those of the type specimens, which were collected at the Cape of Good Hope, but otherwise seem to be the same.

116. *ÆC. PERICLYMENI* Schum.

On *Lonicera sullivantii* Gr. Decorah.

117. *ÆC. PHLOGIS* Pk.

On *Phlox divaricata* L. var. *laphamii* Wd. Decorah, Ames.

On *P. pilosa* L. Ames.

118. *ÆC. PIMPINELLÆ* Kirchr. (*Æ. osmorrhizæ* Pk.)

On *Osmorrhiza longistylis* DC. Decorah.

On *Centa maculata* L. Decorah.

119. *ÆC. PODOPHYLLI* Schw.

On *podophyllum pelatum* L. Decorah, Ames.

120. *ÆC. POLEMONII* Pk.

On *Polemonium reptans* L. Decorah.

121. *ÆC. POLYGALINUM* Pk.

On *Polygala senega* L. Decorah.

122. *ÆC. POROSUM* Pk.

On *Lathyrus venosus* Muhl. Decorah.

On *Psoralea argophylla* Pursh. Decorah.

On *Vicia americana* Muhl. Decorah, Ames.

123. *ÆC. PUNCTATUM* Pers. (*Æ. quadrifidum* DC.)

On *Anemone nemorosa* L. Ames.

124. *ÆC. PUSTULATUM* Curt.

On *Comandra umbellata* Nutt. Decorah, Ames.

125. *ÆC. RANUNCULACEARUM* DC.

On *Anemone dichotoma* L. Decorah.

On *A. nemorosa* L. Decorah.

On *A. virginiana* L. Decorah.

On *Isopyrum biternatum* T. & G. Decorah.

These several æcidia are associated under this name for want of a better way of disposing of them, although it is probable that none of them are identical with the true *Æ. ranunculacearum* of DeCandolle. The one on *Anemone virginiana* is accompanied by *Puccinia anemones-virginiæ*.

126. *ÆC. RANUNCULI* Schw.
On *Ranunculus abortivus* L. Decorah, Ames.
 127. *ÆC. SAMBUCI* Schw.
On *Sambucus canadensis* L. Ames.
 128. *ÆC. TENUE* Schw.
On *Eupatorium perfoliatum* L. Decorah.
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 129. *ÆC. THALICTRI* Grev.
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 130. *ÆC. URTICÆ* Schum.
On *Urtica gracilis* Ait. Decorah.
 131. *ÆC. VIOLÆ* Schum.
On *Viola cucullata* Ait. Decorah, Ames.
On *V. delphinifolia* Nutt. Ames, Decorah.
On *V. pedata* L. Ames, Decorah.
On *V. pubescens* Ait. Decorah.
 132. *ÆC. XANTHOXYLI* Pk.
On *Xanthoxylum americanum* Mill. Decorah.
 133. *RÆSTELIA LACERATA* Fr.
On *Cratægus subvillosa* Schrad. Charles City.
On *C. tomentosa* L. Charles City.
 134. *RÆS. PENICILLATA* Fr.
On *Pirus coronaria* L. Ames, Charles City, Des Moines.
- N. Y. Agri. Exper. Station; Geneva, N. Y., Oct. 30, 1884.*

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MEMORANDUM OF IOWA USTILAGINEÆ.

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BY J. C. ARTHUR.

The following list of species found within the state will serve as a memorandum to collectors. Owing to want of time it has been impossible to work up all the material on hand, or to always give the most approved synonymy.

Each locality is represented by one or more specimens, mostly in the herbarium of the Iowa Agricultural College.

Thanks are due Professor C. E. Bessey and Mr. E. W. Holway for the contribution and loan of specimens.

## USTILAGO BISTORTARUM (DC.)

On *Polygonum incarnatum* Ell. Ames.

## UST. CANDOLLEI Tul.

On *Polygonum sagittatum* L. Charles City.

## UST. CARICIS (Pers.) (U. urceolorum Tul.)

On *Carex pennsylvanica* Lam. Spirit Lake.

## UST. DESTRUENS Duby.

On *Panicum capillare* L. Ames.

On *P. glabrum* Gaud. Charles City.

The spores of American specimens are not smooth but more or less rough and reticulated.

## UST. HYPODYTES (Schlecht)

On *Elymus canadensis* L. Ames.

## UST. JUNCII Schw.

On *Juncus tenuis* Willd. Ames.

## UST. ZÆE-MAYS (DC.) Winter. (UST. MAYDIS DC.)

On *Zea mays* L. Ames, Charles City.

UST. MINIMA Arthur (*n. sp.*)

Spores roundish, either isodiametric or irregularly oblong or ovate, light brown, transparent, smooth, 3 to  $4\frac{1}{2}$  mmm in diameter.

In the inflorescence of *Stipa spartea* Trin. Ames.

## UST. NEGLECTA Niessl.

On *Setaria glauca* Beauv. Ames, Decorah, Charles City.

UST. ROTUNDATA Arthur (*n. sp.*)

Spores exactly round, or irregularly roundish, yellowish to dark brown, translucent, finely and closely papillate, 20 to 25<sup>mm</sup> in diameter; epispore very thick.

In the ovaries of *Panicum virgatum* L. Harrison Co.

This species converts the ovaries into a brown pulverulent mass, but does not affect the external appearance of the flowers or the development of the panicle.

## UST. SEGETUM (Bull) (U carbo DC.)

On *Arrhenatherum avenaceum* Beauv. Ames.

On *Avena sativa* L. Spirit Lake.

On *Hordeum vulgare* L. Decorah.

On *Triticum vulgare* Vill. Ames.

## UST. SPERMOPHORUS B. &amp; C.

On *Eragrostis poaeoides* Beauv., var. *megastachya* Gr. Decorah, Charles City, Ames.

## UST. SYNTHESISMÆ Schw.

On *Cenchrus tribuloides* L. Charles City.

## UST. UTRICULOSA (Nees.)

On *Polygonum hydropiper* L. Charles City.

On *P. incarnatum* Ell. Ames, Charles City, Decorah.

On *P. pennsylvanicum* L. Ames, Charles City.

## SOROSPORIUM BULLATUM Schr.

On *Panicum crus galli* L. Ames, Charles City.

## TILLETIA TRITICI (Bjerk) Winter (T. caries Tul.)

On *Triticum vulgare* Vill. Ames.

A form with smooth spores sometimes occurs, but as it is often intermixed with the rough spored form, it is doubtless only a state of the latter.

## THECAPHORA ATERRIMA Tul.

On *Carex adusta* Boott. Ames.

## ENTYLOMA BESSEYI Farl.

On *Physalis virginiana* Mill. Charles City, Ames, Decorah.

On *Solanum nigrum* Linn. Ames.

## ENT. COMPOSITARUM Farl.

On *Lepachys pinnata* T. & G.

## ENT. MENISPERMI Farl. &amp; Trel.

On *Menispermum canadense* L. Decorah.

ENT. MICROSPORUM (Ung) BeBy.

On *Ranunculus repens* L. Decorah.

DOASSANSIA ALISMATIS Cornu.

On *Alisma plantago* L., var. *americanum* Gr. Decorah.

UROCYSTIS ANEMONES (Pers.) (U. pompholygodes Rabh.)

On *Anemone acutiloba* Law. Ames.

On *A. nemorosa* L. Decorah.

UROC. COLCHICI (Schl) Wint.

On *Polygonatum giganteum* Diet. Decorah.

UROC. OCCULTA (Wallr.) Wint.

On *Elymus canadensis* L. Ames, Decorah.

*N. Y. Agric. Exper. Station, Geneva, N. Y., Oct. 30, 1884.*



